DEFORESTATION: ENVIRONMENTAL IMPACT AND RESEARCH NEEDS

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY

AND THE

SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS

OF THE

COMMITTEE ON FOREIGN AFFAIRS
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DEFORESTATION: ENVIRONMENTAL IMPACT AND RESEARCH NEEDS

THURSDAY, SEPTEMBER 16, 1982

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT, COMMITTEE ON FOREIGN AFFAIRS, SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS,

Washington, D.C.

The subcommittees met, pursuant to notice, at 2:30 p.m., in room 2318, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the Subcommittee on Natural Resources, Agriculture Research and Environment) presiding.

Present, Representatives Scheuer, Bonker, and Carney.

Mr. SCHEUER. This is a joint hearing of the Science and Technology Committee's Subcommittee on Natural Resources, Agriculture Research and Environment, and the Committee on Foreign Affairs' Subcommittee on International Organizations and Human Rights.

This is my colleague, Bill Carney of New York, and we expect soon to have representatives of the Foreign Affairs Committee joining us.

Tropical forests, which include all forests and shrublands in the tropical regions of the world and in other forestry areas, are being lost at an alarming rate. These losses, called deforestation, are occurring because of man's effort to obtain food, shelter, energy, and economic reward, and because too many people and too many animals are trying to survive on too fragile an ecosystem.

As these forests are removed by cutting or by burning, very serious problems are emerging. On a global basis, these problems may even be destabilizing the climate. Hearings that our committee held in 1981 and 1982 clearly demonstrated that the link between deforestation and the increase in atmospheric concentrations of carbon dioxide in the atmosphere were clear and verifiable.

First, when forests are cleared by burning, carbon dioxide is churned into the atmosphere, and burning is a common practice in the developing world to produce land for farming. A second factor, of course, is the loss of trees. When you eliminate a forest, not only do you have the burning but you have the loss of trees which, if they were there, they could remove some of that carbon dioxide by the ongoing, systematic process of photosynthesis.

The net effect of these two phenomena has led to the increase in atmospheric levels of carbon dioxide at a rate of over 1 billion tons annually. Of course, as we know, most of the carbon dioxide emit-

ted is as a result of man's activities and comes from fossil fuel consumption either in homes, places of business, public buildings, or the internal combustion machine.

The total increase in atmospheric carbon dioxide concentration could significantly alter the world's climate, including major changes in temperature and rainfall patterns. On a more basic level, the effects of deforestation are devastating to the developing nations of the world. Nations such as Haiti and Rwanda face intensified erosion of agricultural lands, increased water shortages in dry years, and the loss of species' habitat at unprecedented rates.

The societal rate of deforestation, epitomized by the photographs of starving children caught in the extensive droughts of tropical Africa, sub-Saharan Africa, are all too familiar. Although tropical forests of the United States represent less than 1 percent of the world's total of tropical forests, we are nevertheless not escaping the adverse trends of deforestation.

For example, our pharmaceutical industry depends to a large degree on tropical plants as a source of ingredients. As many as one-half of all the prescription drugs filled in the United States contain ingredients from tropical plants, and it has been estimated that tropical forest depletion has resulted in the loss of thousands of the world's species, many of them necessary for the pharmaceutical industry and our health care. Thus, both the current supply and the future drug potential of new species and the continuation of existing species is being seriously jeopardized.

Another ramification of the loss of species is found in the area of agricultural productivity. American agriculture needs frequent infusions of genetic material from tropical plants in order to meet increasing demands in productivity, pest resistance, drought resistance, and the like. As species are lost, the needed genetic diversity is also lost, irretrievably.

At today's hearings we will examine the status of research on these and other environmental problems that are produced by the phenomena of global deforestation. Witnesses will testify on the research necessary to minimize the impacts of deforestation, and they will testify on the appropriate role of the United States in providing assistance to countries severely affected by deforestation.

Now I would like to call on my friend Don Bonker, who is just joining us, the distinguished chairman of the Subcommittee on Human Rights and International Organizations for the Foreign Affairs Committee, for his opening remarks.

Don, I want to tell you what a pleasure it is for us to organize this hearing with you. The floor is yours for whatever opening remarks you care to make.

Mr. BONKER. Thank you, Chairman Scheuer. I want to commend you for taking the initiative on this issue.

The Subcommittee on International Organizations and Human Rights, which I chair, has long been concerned about the problem of deforestation, and as a result of the Global 2000 report and the U.S. Interagency Report on Tropical Forests a few years back, the subcommittee conducted a series of hearings on tropical deforestation. We heard from administration witnesses as well as those in-

volved in international efforts to address this issue more seriously and comprehensively.

We have continued to prod the interagency task force to accelerate its efforts so that the United States is doing its share, both in terms of bilateral support programs as well as through multilateral efforts, particularly those international agencies who are commissioned to address this most serious problem. We are also aware of a recent GAO study—you perhaps made reference to it in your opening statement—that is fairly critical of the Agency for International Development and its programs on deforestation, the problem being that perhaps more of its money is going to institutions, institutional growth, rather than to directly confronting the issue.

However, in any case, this issue is one of those sleepers. It is out there. Some people know about it; most people are totally unaware of the total effects of deforestation, both in terms of our ecosystem as well as sustaining forests for future use.

Therefore, the subcommittee wholly supports your efforts. I think the more public attention we can focus on this issue, the faster we will come up with remedies and renewed public support for agencies and international organizations to deal effectively with the issue.

I apologize for being late, but our subcommittee was conducting hearings on saving another species—whales—and so we jump from one to the other, but they are both equally important, I think, to the United States. We need to recommit ourselves to their preservation in the future.

I am looking forward to hearing from the distinguished panel of witnesses that you have today.

Mr. SCHEUER. Thank you very much, Don.

My colleague Bill Carney, a very hard-working and concerned member of this subcommittee, the ranking minority member of the subcommittee.

Mr. CARNEY. Thank you very much, Mr. Chairman.

Again, I would like to commend you Mr. Scheuer, for holding these hearings. I personally had the opportunity to see firsthand what adverse effects some deforestation could have down in Panama. The "cut and burn" programs that are going on down there have had a disastrous effect, not only on the natural resource itself, but there is great concern right now as to what the ultimate effect might be to the Panama Canal itself because of the necessity to have water in the lakes above the Canal.

That is just one example of what deforestation can do, and certainly I would hope that this hearing would establish precisely what are the effects of this, worldwide, as far as the loss of biological diversity, the loss of forest resources, soil degradation, and the effects on climate, which you mentioned before, Mr. Chairman, due to the CO_2 levels and the effects that they would have on weather patterns.

Hopefully the committee will be able to establish where we should go as far as our R&D is concerned. We have to know the adequate data upon which to establish resource management practices. We have to have an idea of just how we can go about protect-

ing the natural resources against soil erosion and groundwater contamination and silting that are prominent effects of deforestation. We have to try to determine the environmental consequences of tropical deforestation.

I think our colleague, Mr. Bonker, brought out a very good point when he talked about the loss of product for the pharmaceutical industry. This is something that very few people recognize but it is a reality, that the pharmaceutical industry depends very heavily on the forests of the world, particularly the tropical forests, for many of its compounds and many of its ingredients in the preparation of drugs that we use on a daily basis. To lose ingredients because of inadequate planning with regard to deforestation, would be detrimental to the entire global society.

Therefore, I think, Mr. Chairman, what we should do at this point is to listen to the testimony of the witnesses we have assembled, here today. I congratulate you for the witness list that we have and I look forward to the hearing.

Thank you, Mr. Chairman.

Mr. SCHEUER. Thank you very much.

Let me say before I introduce our first witness that we are very happy to have eight members of the Hubert H. Humphrey fellowship program with us from five countries around the world. They are all sitting in the back row. We hope you have a very interesting experience.

These hearings are for the purpose of educating Members of Congress so we can legislate in more thoughtful, more cost-effective, more meaningful ways.

Now we are going to our lead witness, Dr. Nyle C. Brady, who is with the Agency for International Development, and his colleague, Mr. William Long of the Department of State.

We are delighted to have you, Dr. Brady, although I am a little bit schizophrenic about your testimony because you have been asked to testify on deforestation, but this is a subset of a whole set of hearings we are having on agricultural research and we know you have had extensive experience as a distinguished professor of agricultural sciences at Cornell for many decades and with the Rice Institute in the Philippines.

Therefore, if you wish in your discussion to advert to your perception of what our needs are for agricultural research as well as specific thoughts on deforestation, we would welcome any parenthetical asides you might wish to make on that subject because we know of your great expertise.

Now with that in mind, why don't we yield to you 10 or 12 minutes to chat with us informally? Of course, we have read your prepared testimony with great interest, so if you would hit the highlights in about 10 minutes then we will have a chance to ask you some questions.

STATEMENT OF NYLE C. BRADY, SENIOR ASSISTANT ADMINISTRATOR, BUREAU FOR SCIENCE AND TECHNOLOGY, AGENCY FOR INTERNATIONAL DEVELOPMENT

Dr. BRADY. Thank you, Mr. Chairman.

As you have indicated, my experience has been primarily in agriculture and agricultural research. I have spent the last 8 years in the tropics, working in agriculture, and yet—even though my work was oriented very strongly toward rice and associated topics—I was able during that period of time to witness some of the problems that you have referred to in your opening statement.

As I indicated, during that 8-year period of time I had opportunities to visit probably 40 different countries in the tropics, in Asia, Africa, Latin America. I saw the shifting cultivation that you are talking about, not only from the airplane but down on the ground as we visited with farmers. I have witnessed in Africa, an attempt on the part of agriculturalists to come up with farming systems that would reduce the need to cut down the forests in order tc obtain a little fertilizer and to grow crops.

I am convinced that deforestation, which is brought on by a number of problems but especially by the increase in population in these areas, is one of the most serious economic, social, and political problems that the world faces, and particularly the developing countries. Its impact is serious today but its long-term impact is even greater. We may talk about the short term or the long term in terms of erosion, but the carbon dioxide content of the atmosphere that you referred to is of a longer term nature.

In my written testimony and that of Mr. Long, we recognize that the national and international efforts that have been made in recent years have produced analytical estimates of the rate of deforestation. It is somewhat less in terms of numbers than we had indicated earlier—maybe about 70 percent as great as we thought. Still, when you talk about 7.5 million hectares every year being denuded of its forest, that is a tremendous area that we have to deal with.

There is growing recognition of the need for coordination between those concerned with forestry and those concerned with agriculture. I asked myself as I saw poor farmers on a hillside with their families, in a hut that they had made out of some trees or debris that they had torn down, "What can you do for those people? What can you do, in terms of giving them an opportunity to produce their own food, so that they can have the money to buy food from others and not have to go up on this hillside in this open, public land and destroy it as they are now doing."

There is a growing recognition that you have to have coordination between agriculture and forestry, and that what happens in one very definitely influences the other.

Even though one can be critical of the degree to which there is coordination of all of the organizations in the world concerned with this important problem, considerable progress has been made in the last decade. Mr. Long's analysis of this situation tells very well the degree of coordination that has developed. The U.S. Agency for International Development, which I represent now, has not only supported these coordination efforts but in many instances has taken the leadership in suggesting and formulating them.

One of the conclusions that was reached by U.S. institutions and international organizations is that forestry research and institution building to carry out that research are two requisites for reversing the deforestation trends in the tropics. I am reminded of the situation that I found when I went, as a young professor at Cornell, to the Philippines in 1953 to 1955. I witnessed the efforts of this country to apply directly the technology that we had learned in agriculture to the problems of the tropics, and I saw how miserably those efforts failed; how literally millions of our dollars and those of other donors were essentially wasted because we did not recognize that the technology that fit the situation of the Indian farmer, the Indonesian farmer, the Nigerian farmer, had not yet been developed.

It was not until people decided that it was necessary to go into mission-oriented research to solve the problems that are peculiar to the tropics that significant progress was made in terms of food production in those countries. I believe that forestry is at about that same stage today, and that it has been demonstrated that research is going to be needed.

My agency is taking the lead in organizing networks of cooperating scientists and researchers in appropriate areas of the world to address common themes. Fuel wood production is a common problem in several countries. Maybe the reason you cannot do it is because you do not have species that will grow rapidly on acid soils in one case, alkaline soils in another. Or perhaps we do not understand the social requirements to keep people from cutting down trees before they are big enough to be useful. We just do not understand, and it is going to take some research in order to do that.

We are working on this in coordination with the World Bank, FAO, IUFRO, and the national research organizations. To encourage consideration of the common theme approach, discussions have been held with developing country leaders in Africa and Asia and with members of the European and international research committees. We have begun support for the International Council for Research in Agroforestry in Kenya, to encourage this common theme approach. The approach is still in its planning stage but offers a promise for real contribution.

Some of our people met last week at the East-West Center in Hawaii, with a group of forestry research institute directors from Asia, asking them if they thought this approach would work, and they indeed did. Interestingly enough, they focused on what you have focused on as the most serious problems: on fuelwood, on trying to get reforestation in some lands that are not good for other purposes, and on trying to find out, using social science research, what we can do to get the public behind the notion that hillsides, and even flatlands that have been going to waste, can be revegetated.

I witnessed the almost revolutionary role that research has played in helping developing countries to maintain their per capita food production in spite of unparalleled rates of population increase in the last two decades. I see no reason why that same dedicated and sharply focused attention to forestry research cannot

play a primary role in dramatically slowing the deforestation rate in the tropics and eventually reversing it.

I do not want to give the impression that we have to wait for all the research answers before we can move. But I would argue very strongly that if we are going to make progress over the next 25 years, we are going to have to have research that is related to the problems of forest tree growing and people's utilization of those forests in the tropical countries.

Thank you very much, Mr. Chairman, for giving me an opportunity to make these few comments.

[The prepared statement of Dr. Brady follows:]

STATEMENT OF

Dr. Nyle C. Brady

Senior Assistant Administrator for

Science and Technology

AGENCY FOR INTERNATIONAL DEVELOPMENT

Before the

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT OF THE COMMITTEE ON SCIENCE AND TECHNOLOGY

and the

SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS OF THE COMMITTEE ON FOREIGN AFFAIRS

U. S. House of Representatives

September 16, 1982

I am pleased to be here today and thank you for the opportunity to discuss the accelerating loss and deterioration of the world's agricultural and forest lands and the global significance of the problem.

Extensive misuse, poor management and destructive exploitation have significantly depleted what was once one of Earth's most abundant natural resources. The world's forests are being converted to other land uses at the rate of nearly 11.3 million hectares a year with most of the loss -- 7.5 million hectares -- occurring in the humid tropical forests of the Third World. The single most important cause of deforestation is shifting agriculture which accounts for 70, 50 and 30% of the areas deforested in Africa, Asia and the Americas, respectively.

The pressures of rapid population growth on natural resources are a main cause of this rapidly deteriorating situation. People need land to grow food, wood to burn and raw materials for industry. Out of perceived necessity they are destroying the basis of their livelihood as they exceed the limits of natural systems.

My remarks to you will address the phenomena that are the topics of this hearing --desertification and deforestation. Obviously, loss of productive capability is a major concern. But the social, economic and ecological problems are even greater. They affect the

lives of tens of millions of people whose incomes and nutritional levels are thus reduced, contributing to a greater incidence of disease and sickness, leading in some cases to starvation and death.

Desertification refers to a broad set of undesirable ecological changes that sap the land of its ability to sustain agricultural productivity and support human life in arid and semi-arid regions of the world. Desertification occurs when generally fragile land resources are misused or abused. Extended drought intensifies the problem. The process can be slow, taking a generation or more. Or, the process can be rapid. Whichever, it often results in land that is permanently stripped of productive capability, reduced to eroded and unuseable wasteland.

Deforestation is the loss or removal of forest cover. Forest resources are necessary to serve human needs. The challenge is to use these resources prudently and efficiently to reduce the risk and incidence of the deteriorating effects of soil erosion, stream sedimentation, reservoir/harbor siltation, flooding and other degradating processes. The conversion of forest resources to support agricultural production is a major cause of deforestation. Any solution should thus be deeply immeshed in agriculture.

While deforestation and desertification may be ecological in nature, they are caused by people. But, people can also reverse the

consequences of the phenomena's devastating processes. Technological intervention can and must play a vital part in that reversal. We must keep in mind, however, any such effort must take into consideration the social, political, economic and cultural aspects of a country.

The task goes beyond merely arresting and reversing the effects of desertification and deforestation to carrying out broader-based development. In fact, the latter is essential to the former. You cannot stop either without carrying out broader-based development. In addition to improvements in the physical infrastructure, there must be a more viable social infrastructure, an effective agricultural reform and a slowing of population growth. Without an integrated effort, desertification and deforestation and their accompanying effects of human economic and nutritional deterioration will not only continue but accelerate.

How serious is the desertification threat? Documentation is generally poor. Still, the facts that are available to us provide useful estimates and insights. About a third of Earth's land surface may be climatically classified as extremely arid, arid or semi-arid -- areas where desertification is the greatest threat. They are not, however, the only regions. For example, nearly 1 billion hectares with rainfall in excess of the levels received in semi-arid regions have been degraded to near desert conditions due

to overgrazing, deforestation, burning and injudicious farming practices. Also of concern is the far greater degradation of useful land in zones classified as arid or semi-arid for purely climatic reasons.

As many as 650 million people -- about 15% of the world's population -- live in these low-rainfall areas, with an estimated 80 million living on lands rendered nearly useless because of one or more desertification processes -- erosion, dune formation, vegetation deterioation, salt encrustation, etc. An estimated 50 million of those people face eventual loss of their economic livelihoods as their fields and pastures turn into wastelands. They daily battle undernutrition, sickness and disease. Dispossessed, without land or jobs, they flock to overcrowded cities.

The plight of the people of these dry areas of the world was largely unheeded until the great Sahel drought and famine of the late 1960s and early 1970s. That crisis attracted worldwide attention and resulted in the recognition that the problem goes beyond a mere hiatus in rainfall, that its causes are to be found in social and economic patterns that are incompatible with environmental limitations.

Disasters in such regions are not new; droughts and crop failure have always plagued arid lands. But the scale of human suffering

and the permanency of destruction to arid-zone ecosystems has reached an unprecedented height. Due to rising population growth rates, more and more people rely on the rangelands and croplands in these ecologically and environmentally fragile areas. Traditional social patterns and production techniques are no longer suitable; they undermine the very biological systems upon which lives and livelihoods depend. Furthermore, development has infrequently offered inhabitants alternative ways to live on their lands.

The social systems and ecosystems in most of these arid zones are on a collision course. The question is not whether social and economic patterns within them will change, but how. If humans fail to initiate neeeded economic and political reforms and technological and demographic changes, nature will -- most likely and unfortunately in the form of natural catastrophes.

Within the present institutional context, what is essential to the short-term survival of the individual who lives on such land often flies in the face of what the long-term survival of society dictates. For example, nomadic families keep large numbers of animals to provide them with milk, meat and animal products. Surplus livestock represents an investment and insurance against drought. But in some agricultural situations this hedge can lead to overstocking, overgrazing and rangeland deterioration. Similarly, farmers may have no choice but to plow high-risk marginal fields

when production fails to keep pace with demand.

A better future for the people in arid and semi-arid lands may mean a shift to a system in which livestock is valued for quality rather than abundance; in which farmers grow enough food on the best-suited lands without depleting the soil; in which the human population is maintained within supportable bounds.

Some traditional nomadic practices may no longer be viable. Adopting a modernized way of life may be the only way to safely exploit an area's protein-producing potential. A drastic reduction in livestock numbers and the adoption of modern management techniques may be needed to raise agricultural output. Experts estimate in some cases production can be doubled with half the animals if such practices are employed.

Improving farming in the sedentary zones is also crucial to arresting desertification. Decades of concentration on such export crops as cotton and groundnuts and inadequate attention to more subsistance farming including, for example, the production of millet or sorghum, have resulted in arid and semi-arid regions that have inadequate infrastructure and lack government services, that are desperately short of capital for development and that are restricted by an almost pre-feudal technology. Any serious attempt to improve agriculture and food production in these regions will have to

concern itself with the structural transformation of the rural economy.

In many dryland farming areas, population growth prohibits a return to the previously successful and ecologically sustainable fallow or rotation systems. An alternative is to adapt new, proven cropping systems that minimize erosion, employ water harvesting and conserving techniques, apply animal and green manures and carry out crop rotations.

Such technological change needs to be planned and carried out within a broader framework of sound rural area development. Preventing and reducing the processes of desertification is not a simple task. The causes and processes must be addressed in their entirety, including correcting land tenure patterns that encourage poor land resource use.

A successful social and economic order will require economic cooperation between people and goverments of these regions of the world and those in more favorable climates. An increased flow of resources and information, including technology and expertise is essential to economic development and healthy trade which will benefit both trading partners. Moreover, exports must co-exist with, rather than replace, a self-reliant, equitable and environmentally sound food and agriculture production system.

As with desertification, data on the amount of permanently lost forest cover is difficult to measure; historical records are poor and our ability to monitor deforestation is limited. Estimates made by experts indicate that human activities have reduced closed tropical forests, those providing a continuous ground canopy, by more than 40%.

The 800 million hectares of open forests in the tropics and semi-tropics are also in danger. As much as 4 million hectares a year are seriously affected by the extensive removal of the sparse but important tree and brush cover; as much as half of this hectarage is essentially stripped of its cover -- a major cause of the desertification phenomenon taking place in the arid, semi-tropics and Savannah regions of Africa, Latin America and Asia.

The major consequences of tropical deforestation include extensive clearing to create grazing lands and settlement; intensified seasonal flooding; water shortages; accelerated erosion of agricultural lands; siltation of rivers and coastal waters; shortages of fuelwood; potential local, regional and global climatic changes; and the disappearance of plant and animal species.

The soils, terrain, temperature, patterns of rainfall and distribution of nutrients are in precarious balance in many tropical forests. When these forests are disturbed by extensive clearing

nutrients are leached from the soil, and, where advanced degradation has occurred, neither valuable trees nor productive grasses will grow again. Even where conditions are favorable to regrowth, the unparalleled genetic diversity of the original forest is altered.

The clearing of forests is not necessarily undesirable. It can be a natural part of the development process. But whereas increases in agricultural production in the temperate regions have been achieved through more intensive use of land already under cultivation, agriculture in the more tropical climates often expands onto marginal soils and sloping lands that cannot support permanent cropping or grazing, at least not without special provisions and farming practices.

Without modern inputs -- such as fertilizer and improved seeds, farming know-how and government assistance -- people simply press onto difficult and fragile lands to try to meet their basic needs. Population pressures intensify the inevitable degradation as do other factors, such as the processing of agricultural products (grain drying, tobacco curing, rubber preparation) which require large amounts of fuelwood, and cattle. The animals graze the woodlands, consume vegetation and compact the soil; trees are lopped-off to provide fodder. Fire, an accelerating problem, also contributes significantly to deforestation.

Finally, the cutting of wood for fuel is, in some areas, the major cause of deforestation. More than 1 billion cubic meters are harvested each year for this purpose and the rate is increasing. At least four-fifths of all wood harvested in tropical countries, some 825 million cubic meters, is used for firewood and charcoal; the rest goes into building materials and for export.

While experts all over the world agree that the deforestation problem requires immediate attention, what is less clear is how to curtail its spread and bring about the adoption of measures and practices that will reduce rates of conversion of forest land and permit sustainable uses of converted lands.

As earlier stated, agriculture holds the real solution to some of the most serious forest resource and natural resources problems in the developing countries. Greater attention should be given to using agricultural programs, such as crop production, livestock production and conservation, as instruments for effecting a solution to both food production and forest and related natural resource problems. At the same time, modest forestry activities must be maintained as an important but only partial answer to the problem. The national economic development, local income and employment and private sector involvement potential of forestry and forest resources would of course also continue to be pursued and expanded within the Agency's program.

Not only might the Agency's well-established agricultural program represent a more important instrument for addressing many forestry and natural resources problems than is now widely recognized, but the improvement of farming systems for small farmers can include the use of woody plants in soil nutrient cycling, crop fallows, fruit and nut cash crops, fodder and conservation aspects, as well as in woody biomass production.

A.I.D. and its predecessors were heavily involved in providing assistance to traditional forestry activities until the late 1960s when programs were reduced. Forestry programs were eliminated in the early 1970s as A.I.D. focussed on carrying out its newly designated basic human needs mandate.

However, the 1978 U.S. Strategy Conference on Tropical Deforestation, which A.I.D. co-sponsored with the State Department, identified the serious proportions of the forestry problems affecting developing countries. During the past four years, A.I.D. has been building up its forestry assistance program in two distinct but complementary thrusts -- forestry capacity building through bilateral assistance projects and direct tree planting under Public Law 480 Food Programs.

A.I.D. has 77 projects where forestry is either the sole concern or

a component. Life-of-project costs are $579 million of which $166 million is for forestry. The remainder supports other agricultural, rural development and energy activities. Forestry-related projects are expected to result in 22,198 hectares of trees planted in Africa; 111,464 hectares in Asia; 25,061 hectares in Latin America; and 400 hectares in the Near East. Total: 159,123 hectares.

Some examples of A.I.D. forestry projects in response to the deforestation problem:

-- In Nepal, A.I.D. is helping the government protect and restore the country's soil, water and plant base upon which the rural population is almost totally dependent. A key element of the project is to strengthen the government's and local communities' ability to coordinate and mount rural resource conservation programs. An integrated and complex project, it employs a range related interventions that address the whole social, economic and ecological system in each project area. The interventions go beyond forest management and reforestation and include range management, animal husbandry and livestock production, energy alternatives, improvement in agricultural production, watershed management involving agricultural soil and water conservation and engineering structures, irrigation, fodder production, community drinking water and fisheries.

-- A.I.D. and the Peace Corps are cooperating to develop better qualified forestry volunteers and host-country counterparts in countries where A.I.D. and the Peace Corps already have joint programs. The Peace Corps has carried out a series of country needs analyses in 25 countries. Training materials have been developed for two countries in which expanded forestry programs are planned; 17 volunteers have been trained to work on forest projects in Ecuador and 7 more have been trained for Paraguay. In Niger, Peace Corps volunteers have assisted in seven projects, ranging from forestry and land-use planning to a marshlands survey.

-- Regional forestry workshops involving the Peace Corps, A.I.D. and host-country participants have been held in Costa Rica, the Philippines and Kenya. Six Peace Corps volunteers are working on the Regional Fuelwood Project in Central America and the Natural Resources Management Project in Honduras. Two agreements have been signed with the FAO to facilitate A.I.D. utilization of FAO forestry and related expertise in the rest of sub-Saharan Africa.

-- In Niger, through the Forest Land-Use Planning project, A.I.D. is helping establish a planning and managerial capability in the Ministry of Rural Development and is

preparing a long-term perspective plan for the rehabilitation, conservation and protection of the country's soils and natural vegetation.

-- In Sri Lanka, the Reforestation and Watershed Management project provides technical assistance for the restoration of 20,000 hectares for watershed stabilization and fuelwood. An institutional development component includes a forestry extension program and a forest department mid-level training program.

-- A $25 million social forestry project developed with villages in Madyha Pradesh, India, to plant trees on marginal lands is leading to a similar project in Maharastra.

-- In Haiti, assistance provided to local nurseries resulted in planting more than 300,000 trees. Under the agroforestry outreach project, supported by $8 million in grants, private voluntary organizations are doing extensive planting. Operation Double Harvest, for example, planted 87,000 leucaena trees by May 1981 and transplanted an additional 50,000 trees during September and October 1981; 50,000 leucaena seedlings were sold at subsidized costs to the private sector and subsequently planted. Expansion of the

ODH nursery is underway and a goal of planting 1 million trees by the end of fiscal 82 has been set.

A.I.D. has several agriculture projects directed at integrated food crop, livestock and fuelwood production:

-- Farming Systems Support project -- strengthens developing country agricultural research and extension to promote the integrated analysis of small farm production dynamics.

-- Soil Management Collaborative Research Support Program -- seeks to enhance agricultural productivity by developing agro-forestry systems incorporating trees and perennial crops into present annual crop and pasture systems.

-- Mixed Crop/Livestock Farming Systems project -- seeks to increase food production on marginal lands in the humid tropics by promoting the introduction of pasture and browse legumes in mixed foodcrop/livestock farming systems. These legumes will lead to intensified land use through the production of high quality animal protein food and fuelwood as well as rehabilitation of degraded lands for further food crop production.

A.I.D. recognizes its Congressional mandate to provide assistance

to developing countries that will strengthen their institutional capacity to carry out forestry programs and that will stimulate greater host country commitment to forestry development activities. While amendments to the Foreign Assistance Act have recognized the serious consequences of deforestation, particularly the 1979 amendments to Section 103, the act actually authorizes the Agency to provide forestry-related assistance within a much broader development assistance framework than can be captured by the goal of fignting deforestation.

The 1977 amendments added Section 118 calling upon A.I.D. to "furnish assistance ... for developing and strengthening the capability of less developed countries to protect and manage their environment and natural resources." In 1978, Section 103 was amended to authorize strengthening of forestry and soil conservation services to small farmers. Further, within the broader Agency economic development assistance framework, the Agency also has recognized forestry as being an important economic development opportunity.

Bilateral assistance projects funded under Development Assistance and Economic Support Fund accounts focus on forestry capacity

building to improve forestry support of agriculture, energy and rural development. The Agency designs many of its forestry and natural resources projects to expand, stimulate and promote greater efforts, strengthened capacity and higher priorities for forestry-related programs and management. A.I.D.'s current portfolio of forestry projects must be viewed as only a first generation of assistance interventions, in many cases building on nascent host country concerns in this area. At this early date, prediction of the ultimate capacities and degree of commitment within developing countries cannot be made. In carrying out its programs and projects, A.I.D. seeks collaboration with the Peace Corps, other bilateral donors and international organizations, and the private sector.

A 1979 study of international forestry activities in the developing world shows that the United States ranks only behind Sweden, the World Bank and FAO with funding concentrated on the industrial, integrated development and reforestation/afforestation categories. But there remain large and serious gaps in the technology of establishing, managing and harvesting forests and groups of trees without harming the environment. There is an urgent need to identify missing knowledge and to begin a research program to develop this knowledge.

Longer timeframes for implementing forestry projects may be required to achieve the desired capacity expansion aspects of many of A.I.D.'s forestry-related assistance projects. Extending life-of-project planning beyond the usual five-six year horizon of most A.I.D. projects could bring the scope of activities more in line with a country's realistically assessed levels of commitment and capabilities.

Several areas of forestry research have been recommended by the World Bank, the U.S. Interagency Task Force on Tropical Forests and others:

1. Reforestation and Afforestation: Studies to demonstrate which species in a given area are best suited for different purposes such as fuelwood or fodder; better information on nursery establishment, seed production and plant protection; research on species composition, spacing and configuration of trees for shelterbelts and sand dune stabilization.

2. Wood as a Source of Energy: New methods of estimating and measuring biomass for fuel; work on biomass harvesting and transport and on cookstove design, charcoal manufacture, hydrolysis, gasification, pelletization and liquid fuel technology.

3. Integration of Forest Management into Rural Development: Answers to: How can multiple-use management of natural forests for wood products, fuelwood, livestock, water, wildlife, and other uses contribute to rural development programs? What are ecologically and economically sound patterns of integrated forest, range, pastoral and agricultural land use? What are effective incentives for individuals, communities and enterprises to engage in sound forest management practices?

4. Forest Economics Research: Investigation of the economics of forest plantation culture, erosion control and multiple-use management of natural forests and agroforestry.

5. Industrial Forestry and Resource Conservation: New uses for heretofore unutilized species and new methods to reduce wood losses during harvesting, transporting, storing and processing.

6. Remote Sensing Applications: Additional work so remote sensing can be fully applied as a reliable tool for land and resource inventory, classification and monitoring in tropical settings with mixed vegetation.

7. Silviculture Under Arid Conditions: Research on shelterbelts and windbreaks in arid zones, water harvesting and the use of brackish and saline water for forest tree planting,

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irrigation of trees or trees and agricultural crops combined, and regeneration of arid land shrubs.

As a starting point in this research effort, A.I.D. is cooperating with the World Bank, the International Union of Forest Research Organizations (IUFRO) and the U.S. Forest Service to upgrade forestry research institutions in Africa, Asia and Latin America. Working with IUFRO and FAO, as well as others, A.I.D. will help establish forestry research networks.

Strengthening forestry research institutions will increase the capability of developing countries to solve problems related to the development and use of renewable natural resources with particular attention, for example, to problems of agroforestry, biomass for energy and conservation of tropical forest ecosystems.

The first phase of such an effort would have a small team of forestry experts working with selected forestry research institutions to identify and develop research projects. A.I.D. would then support research networks and fund research projects in several developing country forestry research institutes.

A.I.D. also has forestry activities in a widening network of cooperative and contractual agreements, as well as through unofficial, professional relationships with several organizations.

The most important links are with:

- U.S. Forest Services (USDA), National Park Service (USDI) and the Peace Corps to develop forestry-related programs. The Forestry Support Program operated by the Forest Service has developed a roster of 1,300 forestry experts. The list is used extensively to recruit for A.I.D. field projects.

- International Council for research in Agroforestry in Nairobi, Kenya. A.I.D. has entered into a cooperative agreement to support agroforestry studies, inventories and training programs.

- Food and Agriculture Organization. A.I.D. informally cooperates with FAO's Forestry Department. In January 1982, A.I.D. and Forestry Support Program representatives took part in the Second Experts Meeting on Tropical Forestry at FAO Headquarters.

- International Union Forestry Reseach Organizations. Discussions are underway with the Union to join with A.I.D., the World Bank and other potential donors to examine the best means of strengthening the capability of forestry research institutions in selected developing countries.

In addition, the Administrator has asked that I conduct an expedited review of the Agency's research priorities in a number of key areas of Agency concern. One of these areas is fuelwood, which is of significant importance to our energy, forestry, and environmental programs. Research opportunities identified here will not only advance our capabilities to address the major fuelwood problems confronting rural populations in many of the developing countries, but also will have a positive impact on efforts to address problems of deforestation.

The size of the problem is tremendous. Managerial and technological deficiencies and insufficient funds add to constraints on improved forest management. FAO estimates that $3.3 billion a year is needed to replace wood being cut for worldwide industrial and fuelwood purposes. Despite this discouraging outlook, A.I.D., other governments and international development agencies appreciate the linkage between forests and economic development and have begun to cooperate in attacking the deforestation problem. A.I.D. continues to seek out innovative approaches to these issues and we hope to continue to act both as catalyst and investor in this endeavor.

Mr. SCHEUER. Mr. Long, do you wish to testify?

Mr. LONG. Yes.

Mr. SCHEUER. All right. Why don't we call upon you for 8 or 10 minutes and then we will have some questions for both of you.

STATEMENT OF BILL L. LONG, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, U.S. DEPARTMENT OF STATE

Mr. LONG. Thank you, Mr. Chairman.

I am appearing today in a dual capacity, as Director of the Office of Food and Natural Resources of the Department of State, and also as cochairman of the U.S. Interagency Task Force on Tropical Forests. In my remarks, I would like to essentially update a perspective of the worldwide tropical forest situation that the U.S. task force set forth in its report to the President in 1980.

The task force report supports comments you made earlier, Mr. Chairman, and those contained in Dr. Brady's statement, that tropical deforestation is certainly a serious global environmental problem. However, my testimony, I believe, will be considerably more "upbeat" than most previous presentations you probably have heard on this subject. Over the past 4 to 5 years there has been a tremendous growth in awareness of the tropical deforestation issue and, most important, a tremendous investment of time, energy, financial manpower, and resources. Therefore, I believe that we are now well beyond the point of saying that this is a "sleeper" issue, or that it is being neglected. Rather, the challenge today is to try to focus the myriad of ongoing and planned internation activities in a more targeted, more efficient manner on those special needs that we think deserve high priority.

Therefore, while I want to recognize at the outset that tropical deforestation remains a tremendously serious problem, I also want to highlight the fact that a lot of people throughout the world are worrying about it and, most important, are doing something about it.

First of all, I would like to set forth a number of changing perceptions about tropical deforestation which have occurred over the last 4 years. Dr. Brady touched on several of these. When our task force prepared its report in 1980, the numbers on the rate of deforestation were jumping all around. We, therefore, projected a range of loss—between 10 to 20 million hectares annually. The Food and Agriculture Organization [FAO] and the U.N. environment program [UNEP] have recently conducted a worldwide survey of the situation. That survey provides the best information now available. It shows that the rate of removal is currently about 7.5 million hectares a year, considerably lower than most previous estimates. While this is encouraging, it should not be interpreted that our concern should be lessened because that still is a very high rate of forest loss.

The FAO–UNEP survey also indicated that there are great variations between countries and between regions. The data show, for example, that the estimated rate of deforestation in Latin America is 4.2 million hectares, as compared to 1.8 million hectares in Asia and 1.3 million in Africa.

The U.N. survey is particularly interesting because it represents the emergence of a "system" that should allow us to repeat, and to refine, these measurements on a periodic basis. It is proposed by the sponsoring organizations that the survey be updated every 5 years. With this type of system in place, and with improved and more comprehensive data becoming available through innovative technologies, such as satellite remote sensing, we believe that in coming years we will be in a much better position to determine the rate of deforestation, and also reforestation, with greater precision, at the moment, even the 7.5 million figure is "soft," and I do not believe that most people attribute a whole lot of credence to it. It is, however, the best number we have at the present time, and a considerable improvement over earlier estimates in terms of scientific credibility.

UNEP will be conducting an evaluation of its global environmental monitoring system [GEMS] next year. This will provide us an excellent opportunity to examine just how well that system is operating with respect to renewable natural resource trends, including tropical forest loss, and to reach agreement on what can and should be done in the future.

As late as 3 to 4 years ago, people were still talking about tropical forests as if they were essentially homogeneous. Today, we have a much better conception of the nature of the forests. What is showing up is considerable diversity—diversity in soil types and plant and animal species. This suggests that the strategies to deal with the deforestation situation must vary from country to country and from region to region.

We cite in our prepared testimony the Brazil experience, where the Brazilian Government has prepared a plan for the development of the Amazon based largely on soil types. Other examples can be given. I have with me a clipping from a newspaper in Peru describing an integrated plan to develop their Amazon Basin. Quoting from the article: "According to soil studies, 6 percent of the area is suitable for agriculture and 12 percent for grasslands, whereas 82 percent should stay in forests." We see this type of analysis of the resource base, followed by preparation of a land use plan, being repeated in Indonesia and other countries. It suggests a very hopeful new direction, namely, that the forests will be looked at for their intrinsically unique and diversified values, and development activities then tailored accordingly.

Another changing perception has to do with the causes of deforestation. Four years ago, when we started looking at this issue, many of us heard that the principal cause of deforestation was private industry cutting the forests for timber. Further, U.S. multinationals were alleged to be among the worst culprits. The analyses that we have undertaken, and that the U.N. system has carried out, disprove this. I think there is a unanimous agreement today that the single most important source of deforestation is agricultural development, principally shifting cultivation. According to the recent FAO–UNEP analysis, seventy percent of the deforestation in Africa is attributed to shifting cultivation. The figures in Asia and the Americas are 50 percent and 35 percent, respectively.

Now having described this encouraging evolution of awareness and understanding, the fact remains that forest destruction and

land degradation behavior continue to be profitable in the short term. Education and propaganda about the problem are not enough if deforestation is to be controlled. Effective action depends on the introduction of forest management strategies, and investments in research, demonstration and application, that can provide acceptable economic alternatives to deforestation in the near term. In this regard there is need for greater recognition that, although the lack of scientific knowledge limits decisionmaking, the main problems are sociological and political in nature.

Now with respect to international support for typical forest research—a principal interest of this hearing—the U.S. Interagency Task Force defined a series of research priorities in 1980 that, in large part represented shifts from the traditional focus on industrial forestry toward forestry conservation, multiple use management, watershed protection, and so forth. These "new directions" for forestry research have commanded a great deal of international attention lately, and I believe that the level of resource support which is beginning to be mobilized is very promising.

A milestone was undoubtedly reached with the convening of the 17th Congress of the International Union of Forestry Research Organizations [IUFRO] in Kyoto, Japan, one year ago this month. IUFRO, interestingly, is an international nongovernmental organization. Its membership is 600 forestry research institutions with 10,000 individual scientists. These numbers alone suggest that forestry research is not being neglected.

Most important, in preparation for that meeting, the World Bank and the FAO prepared an analysis entitled "Forestry Research Needs in Developing Countries: Time for Reappraisal." Mr. Chairman, I would like to submit a copy of that report for the record. Not only do I believe that it is the best analysis available, but it also lays out new directions for tropical forest management research along the lines that Dr. Brady suggested earlier, and which the U.S. Interagency Task Force recommended in 1980. The World Bank-FAO report also describes the quite significant level of effort already being made by various multilaternal and national research and development assistance institutions in this field.

Following the IUFRO Conference (which strongly endorsed this report) the World Bank and FAO have continued their examination of tropical forest research needs. In a second joint report (which I would like to submit for the record) the World Bank provides a breakdown of multilateral and bilateral support for tropical forest research. It discloses, for example, that there were 447 forestry projects underway worldwide in 1982, of which 99 were supported by the United States, principally by AID. Total funding for these 447 projects was $1,701,000,000, of which the research component was $143 million—which represents life-of-project financing.

I believe that those of us who have begun to look into this situation in depth have found, as I mentioned earlier, that the level of international effort is much greater than we anticipated. And also that U.S. involvement, particularly through AID, is considerable. Clearly, there is no lack of U.S. participation and leadership in this area.

Last month, a meeting took place in Hawaii, at the East-West Center, which brought together research directors from various

countries and representatives from the World Bank, FAO, and other international organizations. AID and the U.S. Forestry Service were also represented. The purpose was to assess trends in research, and to consider future research priorities. The representatives from the Pacific and the Southeast Asia region looked at the research priorities recommended in the World Bank-FAO report and agreed that they collectively reflect exactly the new emphasis that the area deserves. They stated that, "We support it, and we will support institution building that enables us to go in this direction."

Mr. SCHEUER. What is the new emphasis?

Mr. LONG. There are three suggested areas of emphasis. One is research on the contribution of forestry to rural development. It means looking at the contribution of forest resources to meeting the production, income, and environmental needs of rural people. The second emphasis is research on energy production and use, including firewood. Dr. Brady touched on this. Third, priority is assigned to research on more effective conservation and management of tropical forest ecosystems, with special reference to protection of the environment. These three new directions would not replace research on industrial forestry, but would rather be placed on top of it.

Both the World Bank-FAO study and the meeting at the East-West Center recognized that there is a great deal of effort going on in tropical forest management regard. I will not bother recounting all the international organizations that are presently involved; or all the other developed countries which are working in this area. Again, my point is that there are a lot of organizations at work, and thus I believe that it is now a question of coordinating and focusing this work, rather than mobilizing a fresh effort.

Let me turn quickly to the U.S. role. Tropical deforestation remains one of the U.S. highest priorities in the international environmental field. At the recent United Nations conference in Nairobi which commemorated the 10th anniversary of the Stockholm Conference on the Human Environment, the United States identified three areas which deserve special attention in the 1980's. All three of these apply to tropical deforestation.

The first U.S. priority is natural resource management, with emphasis on curbing deforestation and improving the productive capacity of arid and semiarid lands. The second priority is monitoring and assessing environmental conditions and trends; and the third is environmental education, training, and information dissemination.

At this 10th anniversary meeting it was important and encouraging to many of us that the subject of tropical deforestation was also highlighted by the majority of other governments in attendance (or both developed and developing countries) as an environmental problem requiring high-priority attention for the 1980's.

In looking at the U.S. track record over the past 4 or 5 years, I think a number of accomplishments deserve special attention, and I will just list these off quickly.

First of all, the United States is recognized internationally as having taken the lead worldwide in focusing attention on tropical deforestation, and also in presenting specific proposals on how this

situation should be addressed. Second, interest and awareness in the United States remain exceptionally high. The meetings of our Interagency Task Force, that bring together Federal agency representatives with individuals from the U.S. public sector, are well attended and there is a great deal of interest.

In the face of recent Federal budget cuts, tropical forest management remains a growth area. This is reflected most vividly in the budget of AID, certainly, and also in the level of effort being maintained by the National Science Foundation, the Peace Corps, the Forest Service, the U.S. Fish and Wildlife Service, and the Smithsonian Institution, to name a few of the key contributors.

Collaboration between the United States and other nations has increased, as well as with international organizations. The United States has launched a number of major program initiatives in the tropical forest management area that are important and are receiving international attention. Dr. Brady mentioned several. Let me just cite a few: A $1 million AID contribution to the International Council for Research in Agroforestry [ICRAF] to strengthen that new organization, and to assist it to become the center of a network of organizations in agroforestry; a joint AID-Forest Service "Forestry Support Program" that is providing a centralized capability within the United States for identifying American experts for overseas positions and short-term assignments, and for establishing a group of AID regional foresters; U.S. financial support for the tropical forest component of the Caribbean Action Program; and a strengthening by the Forest Service of its Institute for Tropical Studies in Puerto Rico as a center for training and education. I could mention others but these are sufficient, I believe, to make the point that the U.S. Federal agencies are indeed taking this situation seriously and that they are making a large policy and program commitment to resolve it.

Mr. Chairman, allow me now to describe some of the next steps for the U.S. task force. Among the most important is continuation of the work of the task force as the central coordinating agency within the Government. Second, we want to undertake an inventory and assessment of the U.N. Food and Agriculture Organization in the tropical forestry area. We continue to look to the FAO to play a leadership role. We feel, however, that they have not come as far as we would have liked them to; and we want to see what can be done to strengthen their capabilities and commitment in the area.

Two other future task force interests are worth mentioning. We are looking forward to a review of the Global Environmental Monitoring System scheduled for next year by UNEP as a time to analyze what can be done to strengthen forest monitoring. Better data is a precondition for making better judgments on research priorities, and so forth. Finally, we are looking forward to considering the report of the Office of Technology Assessment on technologies for tropical forest management. That is a very important study. It should give us new guidance on directions the U.S. should take in this area, and also keep the subject of tropical deforestation before the Congress, the public, and the executive branch agencies.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Long follows:]

TESTIMONY
before the
U.S. HOUSE OF REPRESENTATIVES

COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURAL
RESEARCH AND ENVIRONMENT

and

COMMITTEE ON FOREIGN AFFAIRS
SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS

September 16, 1982

on

DEFORESTATION: ENVIRONMENTAL IMPACT AND RESEARCH NEEDS

MR. BILL L. LONG
DIRECTOR, OFFICE OF FOOD AND NATURAL RESOURCES
BUREAU OF OCEANS AND INTERNATIONAL
ENVIRONMENTAL AND SCIENTIFIC AFFAIRS
U.S. DEPARTMENT OF STATE

Chairmen and Members of the Committees,

In May 1980 I had the privilege of appearing before the House Subcommittee on Human Rights and International Organizations jointly with Mr. Max Peterson, Chief of the U.S. Forest Service, to testify on the subject of tropical deforestation and the associated U.S. role and responsibilities. On this occasion I would like to provide an update of the perspectives, activities and plans we described at that time. In so doing, I intend to highlight the research component of tropical forest management which is a particular concern of this joint hearing. My remarks

will reference, and draw heavily upon, the work of the U.S. Interagency Task Force on Tropical Forests established in April, 1979, to coordinate federal activities in this area. The State Department and the U.S. Forest Service continue to co-chair this Task Force.

Changing Perceptions

There has been a rapid evolution of worldwide perceptions about tropical deforestation since the United States first called for international action on this emerging problem four years ago in the UN General Assembly.

Forest Removal Rates: One reason for the change in perception is that the data bases on both the extent of the world's tropical forests, and on trends in deforestation and reforestation, are much improved. Estimates of the rate of removal of tropical forests have varied widely over the years as the result of inadequate data coupled with differences in the definition of what constitutes "tropical forests". The conjecture and controversy over the degree and significance of tropical deforestation was distracting, and constrained attempts to plan remedial actions that would attract broad-based support. For example, in 1980 when the Interagency Task Force prepared its report to the President 1/, estimates of the annual loss of humid tropical

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1/ The World's Tropical Forests: A Policy, Strategy and Program for the United States; Report to the President by a U.S. Interagency Task Force on Tropical Forests, May 1980.

forests ranged between 5.6 million hectares and 20 million hectares. The Interagency Task Force set the probable range at between 10-20 million hectares annually. In 1981, however, the Food and Agriculture Organization (FAO) of the United Nations, under the auspices of the UN Environment Program's (UNEP) Global Environmental Monitoring System (GEMS), carried out a survey of the extent and change of forest cover in 76 tropical countries. This survey incorporated satellite imagery, forest maps, and geographical analyses, and also drew on consultations with local forestry officials. The conclusion was that the present rate of removal is about 7.5 million hectares each year--or slightly over 0.6 percent of the total amount of humid tropical forests--and a number considerable lower than most earlier estimates.

The FAO-UNEP survey also revealed great variation in the rates of deforestation being experienced by different geographical regions, and by different tropical nations. For example, the closed tropical forests of Latin America are estimated to be declining at an annual rate of 4.2 million hectares as compared to 1.8 million hectares in Asia and 1.3 million hectares in Africa. At the country level, some tropical forests are virtually undisturbed while others face imminent extinction. For example, in Africa, deforestation ranges from 0.2 percent a year in Zaire to 10 percent of the productive closed forests of Nigeria and the Ivory Coast. In Latin America, Costa Rica shows an annual deforestation rate of 3.7 in contrast to 0.4

percent for Brazil and Venezuela. And, in Asia, the range is from 4.3 percent annually in Nepal and 3.6 percent in Thailand to 0.5 percent in Indonesia.

Thus, while the estimate for the rate of worldwide tropical deforestation is, happily, lower that most previous estimates, it is no cause for rejoicing. Throughout the tropical world, many nations are confronted by rapid deforestation and attendent economic, social and ecological problems, and forest cover is shrinking virtually everywhere.

The FAO/UNEP survey is of particular interest since it was the first of a series to be carried out within the framework of the GEMS Program, with updates planned at five-year intervals. With the emergence of this fledgling system for tropical forest monitoring on a repetitive basis, and the likely availability of improved satellite coverage of the tropics in the future, information on the extent and trends of deforestation and reforestation should increase rapidly in accuracy, timeliness and utility. Next year, UNEP will be carrying out a comprehensive review of the renewable natural resources component of the GEMS Program. This will provide an excellent opportunity for the United States and other countries to evaluate the state of tropical forest monitoring, to raise again the importance of accurate forest monitoring and assessment, and to press for necessary modifications in the evolving international monitoring program.

Forest Diversity: A second significant change in worldwide perception about tropical forests involves the more sophisticated manner in which they are being viewed, and addressed. Much of the pre-1975 discussions and writings implied that we are dealing with a homogeneous ecosystem. Today, a dominant theme of international meetings, programs analyses and project designs is the great variability in plant and animal species, soil types, and climatic conditions that exist in the forests of the tropics. This leads to two important conclusions: (1) that the world's tropical forests will in all likelihood be subjected to a quite diverse spectrum of management and development approaches; and (2) that our scientific and technological approaches to management and development must be tailored to reflect this broad natural variability.

The impressive Brazilian program to map the soils of the Amazon forests using airborne radar techniques is a case in point. This has led to the design of a master plan for development of the Brazilian Amazon based directly on the productive potential of the different underlying soil types. It represents an approach which is beginning to be followed by other tropical nations--and reflects impressive strides that Brazil has made in recent years to confront the difficult problems of placing the vast resources of the Amazon under sound management. (In this regard, I believe that U.S. efforts to raise the deforestation problem internationally, and the concern expressed by environmental groups in the U.S. about deforestation in the Amazon, proved to be important influences.)

The Brazilian management program for the Amazon is a clear manifestation of worldwide awareness that tropical forests are indeed highly diverse; that how they are used must depend on their particular physical, chemical and biological composition; and that the optimum approach will probably necessitate a mix of management approaches, including conversion to agriculture, industrial forest plantations, and the retention of some forested areas as parks and natural areas.

Closely related to the issue of forest variability is our improved understanding today of what components of tropical forest deserve special attention (and possibly protection) because of certain unique characteristics and values. The U.S. National Academy of Sciences has made particular important contributions in this area through the efforts of its Committee on Research Priorities in Tropical Biology. The Academy has identified, and focused international attention on certain "critical areas" of the tropics (including tropical forests) which require urgent attention by the scientific community by virtue of their richness in genetic diversity and the imminence of the deforestation threat. In addition, the World Wildlife Fund, in cooperation with the International Union for the Conservation of Nature and Natural Resources (IUCN), is in the process of designing an international conservation program on "Tropical Forests and Primates". The program will attempt to focus scientific investigations and conservation strategies on carefully selected bio-geographical provinces of the tropical forests that have unique conservation values.

Thus, we are moving rapidly to the point of being able to focus in much sharper detail on the important components of tropical forests, including tree species, soil types, wildlife, and associated biological systems. This, in turn, will provide a much more rational and effective basis for establishing and pursuing tropical forest management programs, including the research component, over both the short and long terms.

Deforestation Causes: Another important aspect of changing perceptions of tropical forests involves the nature of the deforestation threat. Previously, it had been assumed by many that timber harvesting by private industry causes the major impact on tropical forests on a worldwide basis. There is a broad international consensus today, however, that the most important single cause is conversion of the forests to agricultural use, principally by shifting cultivation. Seventy (70) percent of deforestation in Africa is due to shifting cultivation, while the figures for Asia and the Americas are 50 percent and 35 percent respectively.

In the drier tropics, collection of wood for fuel and charcoal is a dominant source of wood removal and, according to the 1981 FAO-UNEP survey of 76 countries, this actually amounts to eight times the volume of wood removed by industrial logging. Overgrazing and fire are also significant contributors to deforestation in the drier regions of the tropics.

Industrial logging is not viewed by the FAO and UNEP as a principal source of forest impoverishment in either the Americas or Africa due to a relatively low volume of tree removal per hectare. In Southeast Asia, however, it is quite important due to both the intensive nature of the harvesting and the fact that human settlements are expanding rapidly along the logging roads.

This diversity in the sources of deforestation, and in their geographical distribution, again implies the need for careful selection of forest management strategies, including the determination of research priorities. And, realization that the greatest pressures on the tropical forests are being generated by poor people needing land for food production, and wood for energy, has led the international community to place emphasis today on addressing the interrelationships between agriculture and forestry, and between energy availability and forestry, within the framework of rural development programs. It is noteworthy in this regard that the U.S. General Accounting Office, in its recent analysis of Reforestation and Forestry Management Activities in Developing Countries: Is U.S. Forestry Assistance Being Effectively Used?, included as one of three principal recommendations that the Agency for International Development should emphasize strategies designed to integrate its forestry activities into established agriculture and rural development programs.

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One final observation on changing perceptions. Experiences by countries in all regions in recent years with intensified flooding, disruption of water regimes, siltation of water reservoirs, soil erosion and fuelwood shortages have brought home to policy makers what scientists and resource managers have been urging for years...that forests have important social and economic values far beyond their worth as sources of of industrial raw materials. Coupled with the widespread publicity given to concerns about loss of genetic diversity, large-scale extinctions of animals and plants, and possible changes in global climate, it is safe to say there is now widespread recognition of the multiple values of forests throughout the tropical countries as well as elsewhere in the international community.

Having described this encouraging evolution of basic understanding and perception, the fact remains that forest destruction and land degrading behavior continue to be profitable in the short term. Thus, education and propaganda on tropical forest values are not enough if deforestation is to be controlled and the forest resources brought under sound management. Effective action will depend on: (1) the introduction of tropical forestry strategies, and investment in research, that provide acceptable economic alternatives to deforestation in the near term; and (2) greater recognition that, although lack of scientific knowledge limits decision making, the main problems are sociological and political in

nature. The extension of this second point is that further inquiry into the sociological and political aspects of forest use and misuse deserves much higher priority.

International Support for Research

In recent months, tropical forest research--the principal focus of this hearing--has been the subject of considerable international attention. The results, I believe, are encouraging.

When the U.S. Interagency Task Force on Tropical Forests released its report to the President in 1980, it emphasized that significant improvement in tropical forest management could be achieved through application of existing knowledge and technologies. At the same time, the Task Force report recommended the inclusion of a strong research element within an integrated U.S. program on tropical forests, and identified a number of high priority areas on which U.S. and international research should be focused. These recommended research priorities included: methods of reforestation and afforestation; fuelwood energy alternatives; resource conservation in industrial forestry; remote sensing applications; integration of forest management into comprehensive rural development; sociocultural and economic factors in forest management; functioning of forests as natural ecosystems; rates of faunal and floral extinctions associated with forest loss; and relationships between tropical forests and climate. The Task Force further

recommended that a coordinated international program of research be designed and implemented as a component of a broader international action plan on tropical forests.

In February 1980, as the direct result of a U.S. initiative, the UN Environment Program (UNEP) convened the first of two international experts meetings on tropical forests to begin work on a comprehensive, coordinated international work program. The research priorities selected by the U.S. Interagency Task Force were introduced into that meeting, and strongly influenced the recommendations approved by the international experts group.

One year ago this month, a major international event occurred that will likely prove to be a milestone in the field of tropical forest research. This was the Seventeenth Congress of the International Union of Forestry Research Organizations (IUFRO) held in Kyoto, Japan.

IUFRO is an international nongovernmental organization with a small secretariat in Vienna. Its membership is comprised of some 600 forestry research organizations with 10,000 individual scientists. (These numbers alone suggest that forestry research is far from being ignored, leaving aside for the moment the nature of the research.) The organization operates through six divisions: Forest Environment and Silviculture; Forest Plants and Forest Protection; Forest Operations and Techniques; Planning, Economics, Growth and Yield, Management and Policy; Forest Pro-

ducts; and General Subjects. IUFRO's mission is to foster greater awareness of forestry research needs, opportunities and activities, and to promote international collaboration. It has operated mainly in Europe and North America in the past, but its activities have expanded somewhat of late to include tropical and sub-tropical problems; and a major shift in that direction is under consideration.

As a contribution to the IUFRO Congress last September, the FAO and the World Bank prepared a comprehensive study of developing country research needs, based on a survey conducted by the FAO. The study, entitled "Forestry Research Needs In Developing Countries--Time For A Reappraisal", provides the best recent overview we have seen of the status of research and research institutions today, as well as of research priorities and recommended next steps 2/. It draws on the research recommendations of the 1980 UNEP-sponsored international experts meeting, and is entirely consistent with the research directions and priorities set forth by the U.S. Interagency Task Force.

The FAO-World Bank study observed that in the 1970's, over 90 percent of the research expenditures in the forest sector went to industr[illegible] forestry development. By contrast, very little investment was made in research on wood-based energy products--which accounts for over 80 percent of wood consumption in the developing world--or on the conservation

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2/ A copy of this report is being submitted for the record.

and management aspects of tropical forests. The study concluded that changes in international research emphasis are required in light of new global needs and current research imbalances, and also that developing country governments are enthusiastically supportive of such changes. It then recommended three research areas for priority attention:

- o "Research on the contribution of forestry to rural development (i.e., the contribution of forest resources to meeting the production, income and environmental needs of rural people) with emphasis on research into farming systems which incorporate trees, and on watershed protection;
- o Research on energy production and use, into ways and means of increasing the productivity of trees to produce the maximum biomass and energy yield, and into conserving wood resources by more efficient wood use, e.g., via improved wood stoves;
- o Research related to more effective conservation and management of tropical forest ecosystems with special reference to protection of the environment."

It is important to mention that these priorities are meant to supplement research on industrial forestry, and not to replace it; and that the FAO-World Bank study identified specific new directions for industrial forestry research in the 1980's.

In addition, the study called for a strengthening of national institutions in developing countries as the most effective long-term approach to carrying out relevant research and ensuring that results are actually applied. It noted that there already are a large number of high quality research organizations already working in areas of primary concern to tropical developing countries, and identified 90 such insti-

tutions--40 located in developing countries and 50 in developed nations.

Two principal recommendations of the FAO-World Bank study on institutional arrangements are worth noting. The first calls for a "twinning" approach to forest research. This would involve direct cooperation between existing, well-established "centers of excellence" and emerging national institutions on problems of primary mutual interest (e.g., agroforestry). Second, it was recommended that IUFRO should examine its current structure and consider necessary modifications in light of changing worldwide needs; and that consideration should be given to the creation of a small International Forestry Research Secretariat to initiate more systematic research programs in new areas of concern, to assist in securing funding for developing country research programs, and to assist in monitoring progress.

When the IUFRO Congress convened in Japan last September it endorsed the FAO-World Bank study, and requested the two sponsors to explore further the practical and financial aspects of their recommendations.

In May of this year, the FAO Committee on Forestry met in Rome and gave further endorsement to the "new directions" proposed in the FAO-World Bank study. It urged the FAO Secretariat to cooperate closely with the World Bank to ensure that the recommendations are fully addressed by United Nations institutions and individual countries.

Finally, just last month (August 23-28), the East-West Center in Hawaii convened a workshop for forestry research directors from developed and developing country research institutions located in Southeast Asia, the Pacific and the South Asia region. Representatives from the U.S. Forest Service and the Agency for International Development participated, along with officials from other developed countries. The FAO-World Bank study was one of the main background documents. The result of the workshop was a high degree of unanimity between the research institute directors and donor agency representatives concerning the need to shift the emphasis in research toward such areas of concern as agroforestry, fuelwood production, and water catchment protection, as well as on the need for continued emphasis on industrial forestry research. The main point of difference between the recommendations in the FAO-World Bank study and those of the forestry research institute directors at the Hawaii workshop was that the research directors did not assign as high a priority to sociological research.

Two modes of institutional cooperation were recommended at the Hawaii workshop. The first is the establishment of research networks based on a "common themes" approach. This appears to be one of the principal directions in which AID's forestry program is headed, with, e.g., fuelwood and energy alternatives, and reforestation of wastelands and watersheds, as possible major thematic areas for AID concentration.

The second approach involves donor support for building and strengthening specific research institutions in developing countries. This has been the World Bank's approach in recent years and, based on discussions with Bank officials, will continue to be its strategy in an anticipated expansion of World Bank support for tropical forest research. The Bank believes that the two approaches are complementary, and that if the U.S. and other donors focus on research themes, and the Bank concentrates on upgrading developing country institutions, this will be a strong, mutually reinforcing international research strategy. The Bank recognizes, however, that the U.S. bilateral development assistance program in the forestry sector will also continue to include an institution-building component which, at present, provides support for such important institutions as the Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) in Costa Rica.

The financial implications of re-orienting tropical forest research are unclear. This is partly due to the difficulty in estimating the current level of investment necessary to provide a baseline. As forestry research becomes increasingly involved with the interfaces with the agriculture and energy sectors, difficulties in defining and quantifying "tropical forest research" will concurrently increase. The World Bank, the largest supporter of international forestry programs, has recently estimated that it has funded about $10 million in forestry

research since 1966 out of a total forestry investment of $1 billion. At present, the Bank's lending for national forestry research programs amounts to $23 million [3]/ spread over 23 countries, or about 3 percent of its total lending for forestry.

A broad array of other institutions support forestry research. The FAO-World Bank survey provides an excellent overview. At the international level, the International Fund for Agricultural Development (IFAD) finances small forestry components of rural development projects, and the World Food Program provides support for agroforestry research in many countries. The UNDP has been the largest source of technical assistance grant aid, supporting among others FAO's effort to assist developing countries with the design and implementation of research projects. UNESCO's Man and the Biosphere Program (MAB) has been a source of funding for research involving ecosystem behavior and conservation, as well as on the relationships between people and forests. The expanding international network of biosphere reserves implemented within the UNESCO/MAB framework affords a rich potential for baseline monitoring, experimental research, and local participation in tropical forest ecosystems. The World Meteorological Organization, as principal coordinator for the World Climate Program, has carried out limited research

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[3]/ This represents total length-of-project investigation; rather than per year funding.

on deforestation-climate interactions; and the UN Environment Program has financed pilot projects on forest monitoring systems and wood energy alternatives. A newer institution with considerable potential for important contributions in this field is the International Council for Research in Agroforestry (ICRAF) located in Nairobi, Kenya.

Finally, the tropical timber exporting and importing countries, meeting under the aegis of the United Nations Conference on Trade and Development (UNCTAD), have held a series of discussions over the past two years (within the framework of the UNCTAD Integrated Programme on Commodities) which could lead to an international agreement on tropical timber along the lines of those currently in place for rubber and tin. One of the elements of the proposed tropical timber agreement involves support for industrial-related research, with funding to come from voluntary contributions by the timber producing and consuming nations which would participate in any such agreement. It is premature, however, to speculate on whether such an agreement will be negotiated, and whether it will then result in any significant expansion of industrial research in the near term.

At the international nongovernmental level, the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund have been among the leaders in advocating and supporting research on tropical

forest management, particularly on the conservation and wildlife components. In addition, the International Union of Biological Sciences (IUBS) plans to launch a "Decade of the Tropics", in conjunction with UNESCO's Man and the Biosphere Program, that should direct additional attention and scientific research toward tropical forest ecosystems.

The FAO-World Bank study of developing country research needs also cited an array of bilateral programs involving tropical forest research being carried out through public and private institutions in Australia, Belgium, Canada, Denmark, France, Finland, Federal Republic of Germany, the Netherlands, New Zealand, Japan, Norway, Sweden, Switzerland and the United Kingdom. The study also notes that, "The USA (through AID, Peace Corps and other programs) has supported a wide range of small scale research trials, the testing of arid and semi-arid zone species and sand dune stabilization techniques, the introduction of fast growing species such as Leucaena, range management and watershed-related research and, more recently, research aimed at conservation of tropical forest ecosystems."

The World Bank has estimated that the aggregate level of financial assistance being provided by the developed nations for forestry research in the tropical developing countries amounts to less than $10 million per year. This appears to underestimate significantly the current worldwide investment by the development country, and it does not include research supported by private

voluntary organizations, industry nor by developing country institutions. Even if this figure were doubled or tripled, however, it would still contrast starkly with the level of external aid being devoted to agriculture. For the World Bank alone, investments in agriculture are currently approximately $3 billion annually.

The U.S. Role

Tropical deforestation remains one of the U.S. Government's highest priorities in the international environmental field. This was articulated most recently in a major statement of U.S. environmental interests, priorities and objectives presented at the UNEP-sponsored "Session of A Special Character" convened in Nairobi in May to commemorate the tenth anniversary of the UN Conference on the Human Environment.

There the United States identified three areas which deserve special attention by the international community in the 1980's: (1) natural resource management, with emphasis on efforts to curb deforestation and improve the productive capacity of arid and semi-arid lands; (2) monitoring and assessing environmental conditions and trends; and (3) environmental education, training and information dissemination. Clearly, all three are particularly relevant to the tropical forest management sector. (It was also noteworthy that tropical deforestation was one of the problems cited most often by other delegations from both developed and developing countries, and subsequently emerged as one of the conference's priorities for international action.)

The Federal response in this sector continues to be guided by the goals, strategies and program priorities recommended by the Interagency Task Force in its 1980 report. This response involves two principal thrusts, one related to ensuring a strong U.S. contribution to international efforts on tropical forest management; and the second directed at ensuring that the total international effort is well-coordinated and effective.

In reviewing the U.S. "track record" to date, I believe that a number of accomplishments deserve mention:

- The United States is recognized internationally for having taken the lead in focusing attention on the tropical deforestation situation, and in presenting specific proposals on how a coordinated international program should be structured and implemented.

- Interest and awareness in the U.S. public and private sectors remain high judged on the basis of the participation in, and support for, the activities of the U.S. Interagency Task Force on Tropical Forests. Excellent working relationships have been maintained between government and industry in this area.

- In the face of recent budget cutbacks, USG support for tropical forest-related programs has increased, due in large part to expanded programming by the Agency for International Development. In addition, the Peace Corps, U.S. Forest Service, National Park Service, Fish and Wildlife Service, National Science Foundation, Department of Energy and Smithsonian Institution, in particular, are maintaining significant programs which collectively provide a solid U.S. international contribution in this field.

- Collaboration with other nations and international organizations has expanded, opening the way for new opportunities for joint programming and prevention of duplication of effort. The recent close interaction

between AID and the World Bank, the FAO and the World Bank, and the FAO, UNEP and UNESCO are particular cases in point.

- o There is, today, a much better understanding of U.S. interests and responsibilities associated with tropical forest loss. For example, through the work of such organizations as the National Academy of Sciences---and events such as the Strategy Conference on Biological Diversity convened by the State Department, AID and seven other agencies last November--it has been possible to define with much greater precision the economic, social and ecological values of the forests, and to focus attention on the largely unevaluated, but potentially rich, genetic resource base of the tropics.

- o Through studies contracted by the Department of State, a number of important allegations about direct U.S. responsibilities for triggering tropical deforestation have been evaluated, particularly deforestation in Central America caused by U.S. demand for beef, and in Asia and elsewhere in the tropics as the result of the activities of U.S.-based multinational timber companies. We have learned, for example, that there are only 15 U.S.-based logging and forest industry operations of significant size in the tropics, and together they make use of only 4,900,000 m^3 (or 2.6 percent) of all industrial roundwood harvested in the tropics, and only 0.4 percent of all wood harvested for all purposes. [4/]

- o The U.S. has launched a number of new program initiatives in the tropical forest management area that should be perceived worldwide as continuing evidence of U.S. commitment and capability in this field. These include:

  -- a new $1 million AID cooperative agreement with the International Council for Research in Agroforestry (ICRAF) to enable it to strengthen its research and training activities, and to help establish an international network of institutions in the important field of agroforestry;

  -- a joint AID-Forest Service "Forestry Support Program" that is providing a placement service for experts in overseas forestry programs, and which has established

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4/ According to the FAO, 81 percent of the roundwood harvested in tropical countries in 1978 was used for fuel within the country where harvested; the remaining 19 percent went for industrial wood, with about 8 percent of this exported in processed form or as logs.

a network of regional foresters to provide continuing assistance on tropical forest matters to AID field missions;

-- U.S. support for the tropical forest component of the UNEP-administered Caribbean Action Program, through an AID grant of $210,000 to the U.S. Forest Service for development of "Guidelines For Watershed Management in the Caribbean".

-- strengthening by the U.S. Forest Service of its Institute for Tropical Studies in Puerto Rico to expand training and education programs for Latin American foresters, in part as a U.S. contribution to the Caribbean Action Program.

In evaluating progress made in achieving the original goals and objectives defined by the Interagency Task Force, I believe that the major disappointment has been our inability thus far to pin down coordination responsibilities at the international level. The original U.S. concept (presented to the Governing Council of the UN Environment Program and other international fora over the last three years) calls for an international program of tropical forest research, monitoring, training, education and application. The program would be centrally coordinated, and continually assessed and updated, by an agreed-upon existing international institution, preferably the Food and Agriculture Organization of the United Nations. The objectives of such a program include promoting greater program efficiency, identifying and filling of priority gaps, and eliminating duplication of effort within the United Nations system.

Based on the two previously-mentioned international meetings of government-designated experts---the first under UNEP UNEP auspices in Nairobi in 1980, and the second convened by

UNEP, FAO and UNESCO in Rome last January--an acceptable program structure was initiated. The second experts meeting also recommended that the FAO Committee on Forest Development in the Tropics be expanded in membership, and its terms of reference re-defined, to enable it to play the central role of coordinator. The U.S. subsequently notified the FAO of its support for this recommendation and urged a positive response by FAO. Thus far, however, the FAO Secretariat has shown a reluctance to take on this responsibility, and the concept of an internationally-coordinated program is languishing.

The matter of institutional arrangements for the research component of a broad international tropical forest management program has also received considerable international discussion lately. Decisions are still pending, however, on the proper roles of such organizations as IUFRO, UNCTAD and FAO, including responsibility for central coordination.

Next Steps

We intend to continue to use the Interagency Task Force to keep U.S. interests and efforts in this area under review, to press for continued federal agency support for tropical forest activities, and to develop coordinated U.S. positions on our approaches to international institutions and on program proposals developed by other nations and international bodies. This will be accomplished in close cooperation with the non-governmental working group on tropical forest and the National

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Forest Products Association. We are particularly proud of the excellent working relationships that we have maintained with the U.S. private sector, and appreciate the support and assistance they have provided

As one of our immediate priorities, we plan to carry out through the Task Force an in-depth evaluation of FAO's programs, capabilities and plans in the tropical forestry field to determine its capacity and willingness to play the type of role that we--and other governments with which we have consulted--believe is necessary. Other institutional alternatives will be examined if FAO does not appear to be the proper vehicle. We recognize that the FAO is faced with serious budgetary constraints at the moment; and also that concern has been expressed within and outside the FAO about whether efforts to move that institution into greater involvement in forest assessment and management in the tropics might not lead to a reduction in important activities it has been carrying out on forestry management in the temperate regions.

In the months immediately ahead it will also be necessary for the U.S. to maintain, through AID and the U.S. Forest Service, continuing contact with the World Bank, FAO and IUFRO on the matter of tropical forest research priorities and the requisite international organizational arrangements. The U.S. preference at this time is for IUFRO to accept international leadership with respect to research coordination and evaluation.

In addition, we want to ensure that next year's evaluation of UNEP's GEMS Program includes a thorough look at tropical forest monitoring. It appears to be both timely and essential to examine critically the series of UNEP-FAO pilot projects on forest monitoring which have been underway for several years, and to determine whether (and how) we can now move forward expeditiously toward a cost-effective and fully operational systems for monitoring forest cover and trends at the global, regional, and national levels.

The Interagency Task Force is looking forward to evaluating the results of the Office of Technology Assessment (OTA) study of "Technologies To Sustain Tropical Forest Resources". Based on the study outline and the high quality of expertise which has been mobilized for the task, the information and conclusions to be presented should make a significant contribution to improved understanding of the tropical deforestation situation. The OTA study will also clearly ensure that this subject is kept before the U.S. public, the Congress, the Executive Branch, and the international community. In particular, it should prove to be exceptionally useful in helping define and implement a research agenda for the 1980's which matches unique U.S. capabilities and our special interests in tropical forest management to the needs of the international community as a whole.

Finally, it will be important for those of us in the Executive Branch to continue to examine the proper, and the most effective, federal role in this field---including support for

tropical forest research. It should be noted, however, that our judgment is that despite recent cutbacks in funds for research in both the U.S public and private sectors, tropical forest research remains a "growth-area", even though the degree of growth is slower than what all of us would undoubtedly prefer.

With respect to tropical forest research as it relates to watershed protection, rural energy development and food production, the U.S. Government accords high priority to this area as being directly supportive of our overall international development policies and programs. Consequently, the Agency for International Development's funding for the research component of its ongoing tropical forest-related activities in 1982 is approximately $9 million.

We believe that the federal establishment also has a clearly defined role in encouraging and supporting research on aspects of the tropical deforestation situation in which direct U.S. interests are clearly at stake. Research on the relationships between deforestation and possible global climate change is a clear example. The Department of Energy has been funding important research on this issue; and the U.S. has been pressing for international attention to deforestation within the World Climate Program.

Given the fact that tropical timber is not a strategic commodity for the U.S., and whereas Japan and various Western European countries are reliant on the tropics for a major percentage of their wood and wood products, we will clearly look to private industry and other governments to play the lead (although not the exclusive) role in supporting and conducting research on industrial forestry.

It is the area of tropical forest conservation, including protection of biological organisms and overall forest diversity, which poses the greatest problem in terms of mobilizing a strong, coherent international research effort. Virtually all of the major development assistance agencies focus their tropical forest activities on those geographical areas and issues which directly involve large numbers of people. Thus, research on the character, behavior and values of forest ecosystems not yet being affected significantly by human populations is difficult for governments and AID agencies to justify, particularly during times of tight budgets. Consequently, we have looked to international non-governmental organizations, and private sector institutions, to carry much of the load in this particular aspect of tropical forest management.

This does not mean, however, that the U.S. Government is not directly and significantly involved in supporting basic research on tropical forests, and also research applied to forest conservation objectives. This year, for example, the

National Science Foundation has obligated $1.5 million within its Environmental Biology Program for 37 research projects involving biological diversity, ecosystem dynamics, and interactions among people and the natural resources in tropical forests. And the Smithsonian Institution supports a major program of studies of patterns of distribution of organisms and their relationships in the tropics. The annual budget, which includes both administrative and program support for facilities such as the Smithsonian Tropical Research Institute in Panama, is $8 million. In addition, an array of U.S. universities, zoological parks, and private institutions such as the World Wildlife-U.S. are undertaking a broad spectrum of research on tropical ecosystems and associated plants and animals, and in the process also directly supporting developing country scientists and institutions.

At the international level, however, investment in research on the conservation aspects of tropical forest management--and on assessing the full range of economic, social and ecological values associated with the types of unique areas being identified by the National Academy of Sciences and the IUCN--appears to be lagging well behind other categories of research. Changing this will be difficult, particularly in view of the higher priority the tropical countries attach to near-term, development-oriented research coupled with the financial constraints facing the international development community. Increased support by the United States for tropical

forest research, or any other aspects of improved tropical forest management, will have to be justified on the basis of continued examination and clarification of both U.S. interests and responsibilities vis-a-vis those of other governments and international bodies, and also prospects for significant benefits from greater levels of U.S. investment. The U.S. Interagency Task Force will continue to work with the Congress and the U.S. private sector to ensure an appropriate and effective U.S. response in this area.

Mr. SCHEUER. I am going to yield to my colleague, Don Bonker, for questions.

Mr. BONKER. It seems like I have this marvelous sense of timing, Mr. Chairman, as I come in and out of committee meetings, but it does not diminish for a moment my deep interest in this subject.

I am a little concerned that neither one of the distinguished witnesses referred to a recent amendment to the Foreign Assistance Act which was sponsored by myself and is found in section 118 of that act, which requires the President to consider the importance of forestry in, one, formulating and carrying out programs and policies for bilateral and multilateral assistance as well as for private sector activities in developing countries and, two, seeking opportunities to coordinate public and private development and investments which affect forests in developing countries.

There was another provision which related to the overall importance that Congress attaches to U.S. representation at the various international agencies that deal with these matters and calls upon our representation to stress the high priority of forestry programs as well as improved cooperation and coordination among the various agencies.

Now this was the most recent expression of Congress. I am a little disappointed that you have not made any reference to it in your statements. Do these provisions carry any weight over there, or is it just something that you absorb institutionally as you do your work?

Mr. BRADY. That is a very good question. I did not make direct reference to it, although I was under the impression that many of the things that I said and that Mr. Long said were in direct response to the direction that you had given to us within AID, and I can assure you that within AID that is the case. I believe Mr. McPherson indicated the change in total resources that we are committing for forestry and related environment and natural resource activities, going from approximately $13 million in 1978, up to $153 million in fiscal year 1983.

The facts that the particular bureau that I have some responsibility for was set up, that we brought into that bureau a person who is a world leader in this area, that we took the leadership along with others in proceeding with the U.S. strategy conference on biological diversity, very definitely relate to the subject at hand.

This is very good evidence of our giving more concerted effort to the forestry area.

I must apologize for not making specific reference to the fact that you and others had made this requirement of us, I guess I would take the comments I have made as an indication that we are indeed doing so.

Mr. BONKER. Well, it was not pride of authorship that spurred me to ask the question, but only my interest as to whether there is a response, an interest in our congressional action, our mandates in this case with respect to deforestation.

Mr. Long?

Mr. LONG. Mr. Bonker, I believe that your amendment strengthened considerably previous congressional mandates in the tropical deforestation area. We take all of them very seriously. In fact, we use such congressional expressions of interest to provide leverage on programs and budgets both within the U.S. Government and in our dealings with other countries.

I think the record is clear that, beginning with the United Nations General Assembly in 1978, when the United States first raised the tropical deforestation issue, we have consistently pursued this issue in a spectrum of international organizations, including the U.N. Environment Program, the World Meteorological Organization and the FAO. We draw on your amendments to support our efforts. Clearly, we do pay heed to such congressional directives.

Thank you very much.

Mr. BONKER. Well, thank you, Mr. Long. While you are at the microphone, 2 years ago when you testified before our subcommittee you said that the task force hoped to achieve in 5 years certain goals, which you specified. You named, among others, initiation of an internationally-coordinated action group involving research, monitoring, training, education, and so forth, also doubling of the current annual rate of reforestation and of forestation worldwide. You commented on the desire to increase substantially international research and development in tropical forest management and ecosystems. You wanted to launch a major international effort to develop and introduce alternative low-cost energy and food production, which of course are the primary reasons why we have deforestation today, and also to initiate an international program to inventory and catalog unique forest, plant, and animal types.

That is an awfully ambitious set of goals. That was 2 years ago. You had hoped to achieve these over a 5-year period. Do you have something of a progress report?

Mr. LONG. Yes. The goals that were set out in the task force report are looked at by our interagency group from time to time to see how well we are doing. You recognize that a number of these goals are rather vague and nonqualitative but, nonetheless, let me respond quickly.

The first goal talked about policy commitments by virtually all countries by 1985, and the second called for the design of an internationally-coordinated program. We felt that if we could achieve a program agreed to at the international level, that would certainly represent policy commitments by other countries. Unfortunately, our efforts to achieve the type of a program that we had hoped

have bogged down. We made good progress through two international, intergovernmental meetings of experts, but we are hung up at the moment on the matter of who will take the institutional lead.

I believe that when you were out of the room, Mr. Bonker, I mentioned briefly that we are going to take a hard look at FAO's willingness and ability to take that lead. But we have otherwise made good progress toward obtaining support and cooperation from other governments for U.S. initiatives in this area, and I think it is fair to say that both the producer and consumer countries—if one wants to look at tropical forest management in that way—are agreed that improvements have to be made, that new policies have to be shaped, and new research initiated. That is why I believe that we have made significant progress. However, we are falling somewhat short of achieving a structured, coordinated international program.

As far as a doubling of the current annual rate of reforestation and forestation worldwide, our interagency task force included this goal as a target, not knowing precisely what the base number was. Nonetheless, I think it can be shown through FAO-World Bank surveys and through often evaluations that the amount of reforestation and forestation being carried out by various countries has expanded considerably. I do not have numbers but I believe that at the present time the amount of reforestation has certainly more than doubled in the past 5 years. The World Bank and FAO are trying now to pin those numbers down better. I hope that next time we come back, we will be able to be much more precise. Nonetheless, there has been a tremendous worldwide effort in this area that should not be underestimated.

Just a couple of other points: The comprehensive, worldwide analysis of tropical forest, loss called for in the task force report as another 5-year goal, is proceeding through the FAO–UNEP–GEMS program that I mentioned before. We have the ability, now, to refine current numbers even more, so we are making good progress in this area also. With respect to the goal of achieving substantial increases in international research and development, undoubtedly we are not doing enough, but there has been a large increase in support for research on a worldwide scale over the past 5 years. Concerning another of the task force goals, expansion of national parks, wildlife reserves, biosphere reserves is increasing rapidly worldwide; and there is also a great amount of new research and development on low-cost energy and food production systems, as Dr. Brady said.

The last goal the task force established—and this is the area in which I think we have particular problems—concerns the maintenance of biological diversity within tropical forest ecosystems. The conservation side of tropical forest management requires special attention. Governments are currently focusing their efforts principally on tropical forest areas where the people are, while the private sector for the most part, nongovernmental environmental organizations, have been carrying the ball with respect to conservation of more remote areas with unique values. Given present budget constraints, this situation is likely to continue. However, with the rate of deforestation remaining high, and the potential for larger num-

bers of extinctions of plant and animal species, this is one area which I believe requires a hard look to see what more can be done.

In summary, Mr. Chairman, I am upbeat on prospects for attaining the goals set by our task force for 1985. I believe that the international community has made considerable progress over the past 5 years, and I therefore think the goals are correct and achievable.

Thank you, Mr. Chairman.

Mr. BONKER. Thank you, Mr. Long.

Those are all the questions I had, Mr. Chairman.

Mr. SCHEUER. Thanks.

Dr. Brady, I am going to address this question to both of you and you can answer it in your own fashion. You mentioned along the way, parenthetically, that population pressures intensify the inevitable degradation of the forest, as do other factors.

It seems to me that the irresistible pressure of rapid population growth has to be a very central factor in the process of overgrazing, overburning, overuse, that has the cumulative effect known as deforestation, yet you did not mention any population-related program as part of the solution. Dr. Long in his discussions never mentioned the impact of population in creating the problem, nor what the potential of rational population programs could be, intertwined and intermixed with all of the other programs, in terms of a comprehensive solution.

Just as you came here blissfully ignorant of my colleagues deep concern in his amendment, you also came here blissfully ignorant of my deep concern in population issues globally. I should tell you for the record, so as not to appear disingenuous, should you find it out later, that I was chairman of the first parliamentary committee anywhere in the world on population and development. Since then there have been several dozens that have spawned up, and I helped to plan the United Nations conference in Sri Lanka in 1979 on population and development, so that is a matter of concern to me. I was somewhat taken aback that the question of rapid population growth, exploding population growth, did not occur to any of you as something that could be addressed in setting up a comprehensive, multidisciplinary program for the amelioration of deforestation. Do I do you an injustice?

Mr. BRADY. First, Mr. Chairman, I had been told of your interest in this subject, and I welcome it. I think you will notice that I made reference to the population in my opening statement.

I am a soil scientist, and soil scientists have been studying for many years the shifting cultivation techniques of farmers, particularly those in Africa where I guess some 70 percent of the deforestation results. We are keenly aware of the fact that when the population numbers were small, cutting an area, using the nutrients in that area to grow corn, maize, cassave, peanuts for a couple of years, and then moving over to another area, and not coming back to the first area for 10 or 15 years, was a perfectly stable system. There would be some erosion, but not as much, quite frankly, as in the U.S. system of coming in and cutting all the trees and then starting cultivation.

However, we have witnessed the fact that as populations have increased, they cannot wait 10 or 15 years. In some cases it is 3 to 5 years after they get through with one area that they are back

there again. So there is no question that doing something about population numbers has to be a part of the solution.

People are not like corn and wheat. You have to deal with people on the basis of their own cultures and the first thing we have to do is to make them keenly aware that population really is a problem. In some cultures, people do not recognize that having 6 or 10 children instead of 2 or 3—because in the past 4 or 5 of them would die—is making decreasing their potential for achieving economic stability. The first thing you have to do is to get them to recognize that some changes have to be made. We cannot go in and force them.

We have already made fantastic progress in some of the countries of Asia. In cultures where they did not naturally look toward family planning, they are now doing it and putting an increasing amount of their own money into it. The same thing has to be done in some other countries, particularly in Africa, where this problem is so great that in the last decade the per capita production of food went down.

We are working with those countries, trying to get them to see themselves that this is a real problem and then, using a variety of methods that would be appropriate for their culture, trying to help them to do something about this problem.

Mr. SCHEUER. Now do you formally include some kind of population education for the administrators of the program, or population education actually for the people living in these rural farming areas, as part of the AID forestry program? How do you formally relate population concepts to the forestry program which you bring to these countries?

Mr. BRADY. In terms of trying to help the leaders to conceptualize what their problems are, you almost have to start by explaining the effects of their population situation. There is no question that in the conceptualization of projects this theme has to come in.

Now the foresters are not experts in how to handle family planning. That, then, is the responsibility of the local——

Mr. SCHEUER. However, there are population experts in AID.

Mr. BRADY. Oh, yes, indeed.

Mr. SCHEUER. Is there any communication between the people in AID who draw up the forestry programs and the people in AID who draw up the population programs, to get a little comprehensive cross-media thinking and creativity here so that the forestry people could include some population concepts in their forestry programs?

Mr. BRADY. There most certainly is.

Mr. SCHEUER. There are some very outstandingly able population experts in the AID program.

Mr. BRADY. That is right.

Mr. SCHEUER. As a matter of fact, one of them just got elected to Congress a few days ago, or just got nominated to Congress. Mr. Sandy Levin, who was Deputy Administrator of AID, who was head of that population program, just got the Democratic nomination to Congress out of Michigan a few days ago. I am sure he will be making a great contribution here. He may even join me up on this podium some day firing questions at you chaps.

Mr. BRADY. Just as I have a person with fantastic capability in the natural resources and forestry and energy area, we have like-

wise brought in a person from the Population Council with years of experience in Bangkok and elsewhere to add to the population experience. Those people meet with me every Tuesday morning.

Mr. SCHEUER. Well, that is very interesting and very encouraging. What kind of input does your population chap make? May I ask his name?

Mr. BRADY. Jarrett Clinton.

Mr. SCHEUER. I have probably met him, around the world.

Mr. BRADY. He was in Bangkok for many years and before that in Indonesia.

Mr. SCHEUER. Well, of course in Bangkok they have one of the most remarkably successful family planning programs in any developing country in the world, not only in Bangkok but in Chong Mai, out there in the rural areas.

Mr. BRADY. That is right, and he was one that helped in the formation of this.

Mr. SCHEUER. Do you know Mechai?

Mr. BRADY. Yes.

Mr. SCHEUER. Anyway, tell me what kind of a product your population input fellow has. Where has his input shown up in your forestry programs?

Mr. BRADY. I think in terms of the actual implementation of family planning programs, these are normally administered through public health organizations, the ministries of health.

Mr. SCHEUER. Yes.

Mr. BRADY. Therefore, you have to likewise have this kind of interaction between an agricultural officer and a population officer within the AID mission. I am sure that you get this same kind of discussion: What can we do to try to help each other in these programs? I have witnessed this. I have participated in some of their meetings out in the field and I know that you get this kind of interaction.

Now I must say that you do get some compartmentalization, but anyone who knows anything about family planning knows that you have to really put yourself almost in the shoes of those who are to be the benificiaries of this planning, and to think and act as they do. That means that if it is a farm family, they have to know the effects of population on where and how they live; if it is a family that is living on a hillside, they have to do the same thing.

Mr. SCHEUER. You are helping to train the forestry experts of these various developing countries how to suggest, both to the officials and to the family living on the hillside, that there is a natural carrying capacity for that land, so to speak, in terms of the number of people the land can support before these devastating effects leading to deforestation show up. I take it that something like that is in the works.

Mr. BRADY. Yes. The integrated program that is going on in Nepal, where we have tried to consider the total problems facing families that are living on hillsides—from an agriculture, a health, a population point of view—and you get various ministries and extension workers with a common focal point, that is, the farm family, in some cases causing the difficulty, in some cases with the potential for alleviating it.

Mr. SCHEUER. Very interesting.

Mr. Long, can I ask you for your reaction along these lines? How do you—if you do it at all—work population concepts into the programs you are involved in, or how does the State Department——

Mr. LONG. Well, I will make two points at this time, Mr. Chairman: If one looks at the report that our Tropical Forest Task Force put out, and particularly at the description of the pressures on the tropical forests and what the causes are, we began with a reference to the impact of the growth of population. That linkage was made very clear. As we have subsequently discussed this subject in various international forums, we have continued to address the relationships.

I think another point is worth making in this regard. I talked earlier about changing perceptions on tropical deforestation and the perception that it was the forest industry cutting down the forests. This has given way now to a perception that the heart of the problem is really shifting cultivation, and the requirements that poor people have for land to occupy and farm. I believe that this change has made an important difference because it has forced decisionmakers and planners in various countries who are concerned about the deforestation problem to look at the real source of the threat, and to consider strategies for coping with the continuing expansion of people needing the land and the food. If one takes a look at FAO reports, listens to discussions about tropical deforestation in the U.N. Environmental Program, and talks to representatives of other countries, they make this linkage between forest loss and population growth.

Mr. SCHEUER. You raise it. You sort of try to encourage them to think in terms of national population policy as being part of the mix of programs with which they must address the deforestation problem.

Mr. LONG. That is right, except that frankly, Mr. Chairman, we have not integrated our policies on population directly into the forestry. We have talked at length intentionally about the relationships and the importance of dealing with them but we have not made specific recommendations or pursued specific initiatives in that area because most of the forums in which we are working involve forestry-oriented people working on forestry issues. So we make the point, we describe the linkages, but we have made no specific recommendations on how to deal with the problem at this point.

Mr. SCHEUER. Well, now, they will have an expert in forestry, let's say, in any of these developing countries, who go out and function more or less as our county agricultural agents, talking to people and showing them how to farm. Do they do that, showing them how to minimize the likelihood of severe deforestation? Do these countries have experts going out into the rural areas, consulting with people, and carrying on farming education, agricultural education, that will reduce the impact, reduce the likelihood of deforestation?

Mr. BRADY. Yes, they do, but we must recognize that the effectiveness, the background and training of these extension experts is nothing like a county agent in this country.

Mr. SCHEUER. I understand.

Mr. BRADY. Furthermore, they may be lacking in information on exactly what to do in terms of all of the other aspects, other than agriculture, but by setting up programs that are interdisciplinary, you greatly increase your chances of this county agricultural agent knowing something about population, knowing something about forestry, and so forth.

Mr. SCHEUER. Right, and as this chap talks to the families out there in a real-world situation, it seems to me that in addition to giving them farming advice he might suggest to them that there is a natural carrying capacity for that land, which if they exceed, they are going to run into real trouble and degrade the very land that they own, which their sons, their children and grandchildren are going to look to for their livelihood, their life support.

Mr. BRADY. He can even go beyond this. He can point out to them that if the wife or the husband needs further, more detailed information, there is a little information booth. Even the supplies might be made available if they want them for family planning.

Mr. SCHEUER. Right. Absolutely.

Mr. BRADY. That is one of the advantages of this interdisciplinary approach.

Mr. SCHEUER. Have you had any contact with Ambassador Richard Benedick at the State Department?

Mr. LONG. Absolutely, and one of his staff is with me today.

Mr. SCHEUER. Very good. I am sure if you are working closely with Ambassador Benedick, you are beginning to interweave some population and family planning and child spacing concepts in with the other kinds of counseling that you are helping these nations provide to their own people. Is that a hope that we would have?

Mr. LONG. That is a hope. We have talked with Dick Benedick and his people over the past couple of months about how we can better integrate population concerns not only into tropical forest management activities but also into a broader range of renewable natural resource issues.

Mr. SCHEUER. Right.

Mr. LONG. We are looking for those linkages. At the international level people are talking more and more about the relationship between population resources and environment, and that is a healthy trend.

At this time, however, I must say that the relationship, the interaction, between our forestry efforts and Ambassador Benedick's office probably has not been all that you would like to see, and we are working on it.

Mr. SCHEUER. Very good.

Well, we will finish up this panel on that upbeat note. We want to thank you for your very thoughtful testimony, your stimulating testimony, and for your patience in staying here so late and for answering all our questions.

We do have some additional questions that we will ask you in writing, and we will be grateful for your time and effort in answering them. [See appendix, p. 129.] We will look forward to having you back as we proceed with these hearings that are basically addressing the question of what kind of agricultural and natural resources indeed should our country be engaging in most effectively to help

the developing world countries improve their standards of living and their general well-being.

Thank you very, very much.

Mr. BRADY. Thank you, Mr. Chairman.

Mr. SCHEUER. All right. We will now go to the second panel, Mr. Bruce Ross, Mr. Frank Conahan, and Dr. Noel Vietmeyer, if you will come and join us.

We have with us Dr. Frank C. Conahan, Director of the International Division of the General Accounting Office; Dr. Noel Vietmeyer, professional associate at the National Academy of Sciences; and Mr. Bruce Ross-Sheriff, Project Director of the Food and Renewable Resource Program of the Office of Technology Assessment. We are delighted to have all of you and we look forward to your testimony.

Why don't we start out with Mr. Frank Conahan? You can give us an overview of the study that the GAO has just finished on changes needed in U.S. assistance to deter deforestation in developing countries. How can our country do a better job of helping developing world countries get a handle on the devastating pace of deforestation?

We are delighted to have you. We have our egg timer going because we are running very, very late, so I suggest that each of you take about 8 to 10 minutes—no more than 10 minutes—and then we will have questions for you.

STATEMENT OF FRANK C. CONAHAN, DIRECTOR, INTERNATIONAL DIVISION, GENERAL ACCOUNTING OFFICE

Mr. CONAHAN. Thank you, Mr. Chairman. I am sure that I can get through in the 8- to 10-minute time limit.

Before I summarize the report, Mr. Chairman, I think based on the comments that we heard from the earlier witnesses, I would like to make the point that we reviewed the specific AID activities being carried out in developing countries to address this particular situation. There was an awful lot of discussion about increased attention to this area generally, to research, to coordination and leadership.

Those matters in a general sense were not really part of our review. Our review dealt with host country commitment and capability to the projects being financed by the Agency for International Development, the need for better integration of forestry assistance with agricultural assistance, and donor coordination, primarily at the project level. I would like to summarize those three matters briefly.

Our report concludes that the forestry projects which AID—and other donors, recently—approved, were experiencing delays because host government forest service organizations have been unable to obtain the necessary financial and political commitments from the governments to effectively reform existing land-use practices and in some cases related laws and policies, and funds required for counterpart contributions to the projects. The developing countries we visited were attempting to solve their problems and were working with AID to solve project implementation problems.

The very real economic, political, and social problems, however, limit the ability of these countries to ease the population problems on the mountains, hillsides, and other marginal lands not suited to intense cultivation and grazing. Other studies show that AID's program in other countries may be having similar problems.

Although the developing countries have established forest service organizations, they are insufficiently funded by their governments and do not have sufficient trained staff to undertake the projects which AID proposed, some involving new and untested technologies. Current project implementation is uncertain. In two cases, because of this, AID has withheld the disbursement of project funds.

We have recommended that AID support forest-related activities that countries are capable of carrying out. In cases where host government political and financial commitment is weak or nonexistent, AID should work to engender more positive commitment to deforestation problems. We have also recommended that AID assess the implementation problems which have delayed some projects and, where problems are attributable to limitations on host government capabilities, adjust the projects to better suit what they are able to presently do.

We believe this will necessitate a willingness on the part of AID to plan fewer activities and accept the need for possible successive projects to help satisfy the longer-term forestry assistance requirements of developing countries.

Concerning the integration of forestry and agricultural assistance, the principal cause of deforestation which has been discussed earlier today—that is, the subsistence farmers' clearing of forests for pastures, farmland, fuelwood, and livestock fodder—is not being adequately addressed, in our opinion, in U.S. assistance activities. We found that fuelwood projects which AID and other donors funded do focus on alleviating a major cause of deforestation but, since these projects will not satisfy the increasing demand for fuelwood, deforestation in developing countries will continue.

Forestry and natural resource projects which place considerable emphasis on strengthening host government forestry programs do not focus enough attention on the principal cause of deforestation, and development assistance project planning can have a more direct, immediate, and lasting impact on the principal cause of deforestation through integrated forestry and agricultural programs.

Many AID projects are attempting to bolster the capabilities of host government forest service organizations in order to encourage forestry and natural resource conservation among developing countries' subsistence farmers. The effectiveness of this approach is questionable, in our view, because the forest service organizations lack the financial and political support of their governments and extension systems necessary to introduce improved and sustained practices to subsistence farmers.

Greater use of established agricultural extension systems in lieu of creating somewhat duplicative forest service extension systems could more immediately introduce improved forest and land-use conservation practices to subsistence farmers. AID and other donors have endorsed strategies in their policy papers which would

encourage greater use of this approach by integrating forestry and agricultural programs.

Some degree of integration is taking place. However, using agriculture programs for solving food and forestry problems will not realize its full potential unless AID and other donors make a concerted effort to convince developing countries to include the landless and small landowner farmers as part of any solutions. These subsistence farmers will continue to be the cause of serious environmental and forest-related destruction until means for livelihood are improved.

The assistance sponsored by AID and other donors to build management capabilities of forest service organizations will be needed to bring about long-term and sustained forestry programs in developing countries. We believe, though, that some of the emphasis on forest service institution-building can be reduced. If some of the emphasis on forest service institution-building can be reduced, the host government counterpart contributions and recurring budgetary expenses might be correspondingly reduced, thus easing serious implementation problems.

Further, better use of established agricultural extension systems may also help overcome the problems associated with changing attitudes of subsistence farmers about forestry and natural resource conservation.

Just a word in conclusion, Mr. Chairman, concerning donor coordination. Coordination and cooperation among international donors at the country level is infrequent and not encouraged, for the most part, by host governments. At the international level, efforts to establish a focal point to coordinate international action on forestry have not been very successful. I do not think that this is terribly at odds with what the earlier witnesses spoke of.

The lack of coordination is attributed to a lack of country interest, varying political and economic interests of the donors and the countries, and some competition among donors. In our report, we conclude that the Department of State, AID, and other involved agencies must continue their efforts to coordinate where possible, both at the international and country levels.

Mr. Chairman, that summarizes our report, I believe.

[The prepared statement of Mr. Conahan follows:]

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Statement of

FRANK C. CONAHAN

Director, International Division

before the

Subcommittee on Natural Resources,

Agriculture Research, and Environment

of the

Committee on Science and Technology

and the

Subcommittee on Human Rights and International Organizations

of the

Committee on Foreign Affairs

U.S. House of Representatives

Chairmen and Members of the Subcommittees:

We appreciate the opportunity to provide you copies of our Report "Changes Needed in U.S. Assistance to Deter Deforestation In Developing Countries" issued today. My testimony will summarize the major issues addressed in the report and the responses of the Department of State and the Agency for International Development (AID) to our report recommendations.

The forests of most developing countries, once considered renewable natural resources, are not being replaced quickly enough to sustain an adequate natural resource base to support the growing populations. Although the extent of environmental damage associated with the destruction of forests varies among developing countries, its primary cause is principally the same and is linked to the clearing of forests and vegetation cover--for more farmland, pastures, fuelwood, and livestock fodder--by a predominantly agrarian population.

Developing countries are not making the necessary financial and political commitments to (1) deter the environmental problems brought on by the destruction of their forests or (2) sustain the assistance provided by AID and multilateral development banks and other international organizations. In addition, assistance recipients are finding it difficult to implement and manage forestry projects.

BACKGROUND

Since 1978, the AID program has provided $579 million for 72 forestry-related projects of which $136 million was for discrete forestry activities. AID forestry projects and forestry components of AID agriculture and rural development projects, include the provision of services, equipment, education, and technical assistance mostly through the host-governments' fledgling forest service organizations. These projects are to

assist the developing countries to: collect and analyze natural resource data; develop land-use resource plans; and plant trees for fuelwood, watershed protection, and commercial forest production. Similar programs of the multilateral development banks and FAO, to which the U.S. contributes, include $1.2 billion for planned and approved commercial forestry projects and $481 million for forestry assistance projects. We visited five developing countries which were selected to achieve balanced regional coverage of developing-country deforestation problems and donor programs in Asia, Africa, and Latin America.

HOST-COUNTRY COMMITMENT AND CAPABILITY

Our report concludes that the forestry projects which AID and other donors approved were experiencing delays because host-government forest service organizations have been unable to obtain the necessary financial and political commitments from their governments to

--effectively reform existing land-use practices and, in some cases, related laws and policies and

--fund required counterpart contributions and recurring budgetary expenses for forestry projects.

The developing countries we visited were attempting to solve their forestry problems and were working with AID to solve project implementation problems. The very real economic, political, and social problems, however, limit the ability of these countries to ease the agrarian population pressures on the mountains, hill-

sides, and other marginal lands not suited to intense cultivation and grazing. Other studies show that AID's programs in other countries may be having similar problems because forestry and natural resource conservation have been and continue to be a low priority for most developing countries, which are beset with higher-priority economic and agriculture problems.

Although the developing countries have established forest service organizations, they are insufficiently funded by their governments and do not have enough trained staff to undertake the forestry projects which AID proposes, some involving new or untested technologies. Current project implementation is uncertain. In two cases, AID has withheld the disbursement of project funds because countries have been slow in complying with project conditions and covenants.

We have recommended that AID support forestry-related activities that countries are capable of carrying out. In cases where host-government political and financial commitment is weak or non-existent, AID should work to engender more positive commitment to deforestation problems. We have also recommended that AID assess the implementation problems which have delayed some projects and where problems are attributable to limitations on host-government capabilities, adjust the projects to be better suited to developing-country capabilities. We believe this will necessitate a willingness on the part of AID to plan fewer activities and accept the

need for possible successive projects to help satisfy the longer-term forestry assistance requirements of developing countries.

DOES U.S. ASSISTANCE FOCUS ON THE PRINCIPAL CAUSES OF DEFORESTATION?

The principal cause of deforestation--the subsistence farmers' clearing of forests for pastures, farmland, fuelwood and livestock fodder--is not being adequately addressed in U.S. assistance activities. We found that

- --fuelwood projects, which AID and other donors funded, do focus on alleviating a major cause of deforestation. But since these projects will not satisfy the increasing demand for fuelwood, deforestation in developing countries will continue;
- --forestry and natural resource projects, which place considerable emphasis on strengthening host-government forestry programs, do not focus enough attention on the principal cause of deforestation; and
- --development assistance project planning can have a more direct, immediate, and lasting impact on the principal cause of deforestation through integrated forestry and agriculture programs.

Many AID projects are attempting to bolster the capabilities of host-government forest services to encourage improved forestry and natural resource conservation among developing-country subsistence farmers. The effectiveness of this project approach is questionable in our view because the forest services lack the (1) financial and political support of their governments and (2) extension systems needed to introduce improved and sustained conservation practices to subsistence farmers.

Greater use of established agricultural extension systems in lieu of creating somewhat duplicative forest service extension systems could more immediately introduce improved forest and land-use conservation practices to subsistence farmers. AID and other donors have endorsed strategies in their policy papers which could encourage greater use of this approach, by integrating forestry with agriculture programs.

Some degree of integration exists, as noted in our report. However, using its agriculture program for solving food and forestry problems will not realize its full potential unless AID makes a concerted effort to convince developing countries to include the landless and small landowner farmers as part of any solutions. These subsistence farmers will continue to be the cause of serious environmental and forest-related destruction until means for livelihood are improved.

The assistance sponsored by AID and other donors to build management capabilities of forest service organizations will be needed to bring about long-term and sustained forestry programs in developing countries. We believe, though, that some of the emphasis on forestry institution building can be reduced. If some of the emphasis on forestry institution building can be reduced, the host-government counterpart contributions and recurring budgetary expenses might be correspondingly reduced, thus, easing serious implementation problems. Further, better use of established agricultural extension systems may also

help readily overcome the problems associated with changing the attitudes of subsistence farmers about forestry and natural resource conservation. In the countries we visited, the forest services generally have a credibility problem with subsistence farmers because of their policing activities which attempt to keep subsistence farmers away from forested regions. As a result, farmers have come to resent the forest service projects.

We have recommended that AID and other donors focus increased attention on strategies to slow the destruction of forests caused primarily by subsistence farmers. Doing more includes working to settle subsistence farmers into more permanent and intensive farming systems. This could include:

--more education in the use of land, fertilizer, seeds, and available water for irrigation;

--more community-oriented training in participative fuelwood production;

--more activities to increase small farmers' incomes, such as resin extraction, bee-keeping, fuelwood and charcoal production, and small wood products and handicraft enterprises; and

--the establishment of forest service credibility among villages through better-planned pilot projects to demonstrate the maintenance and use of nurseries.

The fact that these problems are being addressed by AID and other donors, to varying degrees and with some success, is evidence that the problems are susceptible to some measure of resolution.

MORE DONOR COORDINATION AND DEVELOPING-COUNTRY COOPERATION IS NEEDED

Coordination and cooperation among international donors at the country level is infrequent and is not encouraged by host-governments. At the international level, efforts to establish a focal point to coordinate international action on forestry has not been very successful. The lack of coordination was attributed to (1) a lack of country interest, (2) varying political and economic interests of donors and the countries, and (3) competition among donors. In our report we conclude that the Department of State, AID, and other involved agencies must continue their efforts to coordinate, where possible, both at the international and country levels.

AGENCY COMMENTS AND OUR EVALUATION

AID generally agreed with our recommendations. AID noted however, (1) the need for longer timeframes to effectively plan, carry out and sustain forestry and related natural resource projects, and (2) the effective use of existing agricultural extension services must take into account their strengths and weaknesses on a case-by-case basis.

AID agreed that developing countries should not be saddled with more forestry assistance than they can use and that the Agency's current program tends to be integrated and directed more to building institutional capacity. The Agency also pointed out that there are occasions when forestry assistance is best suited to discrete forestry projects. AID sees its current portfolio

of forestry projects as only a first generation of assistance efforts. Because many projects are building on emerging host-country concerns, AID believes it is too soon to predict developing-country commitment. In this regard, the Department of State felt that our report did not adequately recognize the rapid growth of worldwide concern about forestry loss or that developing countries are beginning to respond to a rapidly developing situation.

Our report points out that AID should tailor its forestry assistance to what the developing countries can reasonably be expected to implement during the life of the project. Our recommendation is not intended to imply that AID should only be involved in forestry activities where institutional capacity is already established. We are suggesting that AID project planning more carefully assess, on a country-by-country basis, both the existing and near-term potential capabilities of countries to meet the political and financial requirements of AID project covenants and conditions.

I believe it is important to note that our discussion of host-government commitment is not intended to imply that developing countries do not care as much as the United States does. We are pointing out, however, that donor forestry assistance planning needs to realistically assess existing and potential capabilities and constraints on host-governments which directly impact on the implementation and sustainability of forestry projects.

This concludes my statement. We would be pleased to answer any questions you or other members of the Subcommittees may have.

Mr. SCHEUER. Thank you very much, Mr. Conahan.
Dr. Noel Vietmeyer, may we have your testimony?

STATEMENT OF DR. NOEL VIETMEYER, PROFESSIONAL ASSOCIATE, NATIONAL ACADEMY OF SCIENCE

Dr. VIETMEYER. Thank you, Mr. Chairman.

I appreciate this opportunity to be here. I am Noel Vietmeyer, and I am testifying on my own behalf. However, I am basing it on studies that I have been involved with in my job at the National Academy of Sciences.

Now our program at the National Academy of Sciences seeks out innovations that can help solve problems of developing countries. We look for the exotic things, the offbeat and the unusual topics, and for several years now we have been exploring ways by which countries might slow down tropical deforestation. In fact, we are working with reforestation, and the result has been a number of Academy books. I have given some to the staff and I have another collection here if you would like to have them.

We deal with trees with strange-sounding names, trees that few people ever heard of, like leucaena, mangium, calliandra, casuarina. Few of the world's foresters, actually, have heard of these particular trees. However, the reason why we selected them is because they could be a kind of shock troop for the war on deforestation because these are rough, rugged trees that may not be best for formal forestry—many of them do not have tall, straight stems—but they can create a bridgehead by retaking land that was once forest but has now been lost to hostile weedy grasses. By providing the tropics with wood for fuel and other uses, these vigorous and fast-growing trees can help protect the fragile remains of the original forest.

Also, most of the trees that we have been dealing with are able to fix nitrogen from the air, and thus in a way they manufacture their own fertilizer and carry their fertilizer with them, and this gives them a competitive edge.

One of our reports has dealt with a technique that sprays tree seed from a helicopter or a plane. Now when the species and sites and seasons are favorable, this is a method that can initiate tree growth over thousands of acres a day. You know we seed rice fields and soybean fields and clover on pastures by aircraft, using planes and helicopters, and it turns out that some foresters have done the same thing with trees. In fact, in the South we have more than 1 million acres of pine forest that was seeded using aircraft. This is a technology that is not widely known or widely appreciated in forestry circles, and yet it is the kind of thing that in the tropics with deforestation could play an enormous role.

Therefore, we have looked at these very peculiar species, we have looked at this technique of aerial sowing of forests, and we are now starting to look at some tropical animals. The reason for this is that, as we heard earlier today, much of the deforestation is to create pastureland, and that is because the cattle and sheep and animals that we grow now are grazing animals that require open spaces.

However, there are in the tropics a range of animals, cattle-like animals, that are indigenous to the forest, that live within the trees and the spacings between the trees. We have a book looking at some of these because we think that they could be a way to provide meat and animal resources without destroying the forest.

Mr. SCHEUER. Which animals would they be? Would I have heard of these?

Dr. VIETMEYER. These are animals like gayal, gaur, kouprey, and anoa. There are very few animal scientists who have heard of them. Some of these are on the verge of extinction. Several of them are already domesticated. Gayal and banteng, for instance.

Mr. SCHEUER. What type of animals are they? Similar to cows or sheep, goats, or what are they?

Dr. VIETMEYER. Most of these are vaguely like cattle.

Mr. SCHEUER. They look like cattle?

Dr. VIETMEYER. Yes, smallish cattle.

Mr. SCHEUER. That is fascinating.

Dr. VIETMEYER. Now, other animals can also give a handle on preserving the forests, animals that require forest habitat to live in. The one country in the world that is really pioneering this work is Papua, New Guinea. If you ever get in that area of the world, I recommend that you see it. My written testimony contains quite a bit of information about Papua New Guinea because I am excited about that place.

Mr. SCHEUER. Let me ask—and I do not wish to interrupt—are these animals whom you just named and described, can they survive in all kinds of tropical habitat or is there only just one special tropical environment in which they can thrive? Could they survive in any kind of a tropical forest typically found all over the world?

Dr. VIETMEYER. OK. Banteng, gayal, gaur, kouprey, and anoas all come from the lowland, humid tropics, most of them from the region between India and Indonesia, eastern Indonesia.

Mr. SCHEUER. What I am asking is, could you transplant them to the Amazon, could you transplant them to the tropical forest that is about 45 minutes outside of San Juan, Puerto Rico?

Dr. VIETMEYER. It is highly speculative but I do not think anyone could come up with a reason why you could not.

Mr. SCHEUER. Fascinating.

Dr. VIETMEYER. Now some of the forest animals that are being raised in Papua, New Guinea include crocodiles, butterflies, deer, wallabies, and some flightless birds. It is really fascinating to see something like a butterfly farm. It sounds trivial but village people are raising—there are more than 500 butterfly farms in Papua New Guinea—and they can raise them without putting in fences, without artificial insemination and veterinary services and without worrying about disease, without destroying their village life, and these beautiful tropical butterflies are worth more than a cow, ounce-for-ounce. It is a very clever program. They found what to plant for the butterfly's entire life cycle.

The Papua New Guinea butterflies sell anywhere from $1 to $50 each and they weigh about an ounce.

Mr. SCHEUER. Who do they sell to, and for what use?

Dr. VIETMEYER. These go to collectors, entomologists, and more and more to everyday people who like decorative items for coffee

tables, or for decorative items set in plastic. The market is much larger than you would think. Taiwan and Brazil even now export the by the millions, tens of millions of butterflies.

Therefore, this is a tropical resource that is not the kind of thing we think of, and yet by raising it it gives an economic incentive to keep the trees there because these animals require the forest. That is the source of the raw material, so this is the way that you provide an economic incentive to keep the trees standing.

Mr. SCHEUER. Therefore, you have a sort of an emerging cottage industry there.

Dr. VIETMEYER. That is right, it is a cottage industry, based on the tropical forest standing rather than felled.

Mr. SCHEUER. Yes.

Dr. VIETMEYER. Now I started off by talking about some of these very fast-growing, rugged trees that fix their own nitrogen. Just to give you a sense of the rate of growth, I brought along a sample.

Mr. SCHEUER. I would have preferred if you had brought a whole variety of those butterflies and perhaps some of those esoteric forest animals.

Dr. VIETMEYER. I wish I could have done it. I will send you some. [Laughter.]

This is a cross-section of a stem of a tree that is in the first book we published, this one, called leucaena. This tree was 6 years old when it was cut down. I have it on the best of reference that it was 6 years old. It could not have been more than 8 because the seed of this variety was not available 8 years before this was cut. This is the kind of growth, and this is incredibly dense wood. This is not like balsa.

Mr. SCHEUER. That, too, could grow anywhere in the ordinary tropical forest environment?

Dr. VIETMEYER. This is a native of Guatemala and Central America. It was discovered by accident by a horticulturalist from the University of Hawaii. It grew with this kind of speed when he put it in near Honolulu. You can also see that it is really quite nice timber.

Now what has happened with this species, it has been called a kind of a miracle tree and several of the world's national leaders have taken this on. In fact, if you get to meet Mrs. Marcos this week, she will probably tell you about it. Filipinos call it giant ipil-ipil, and Mrs. Marcos has planted it all over Manila, and there are all kinds of programs to plant it in many parts of the Philippines.

Now more recently Mrs. Ghandi has taken up the cause of this plant. She calls it kubabul, and Mrs. Ghandi is promoting its cultivation on the eastern and western coasts of India.

I noticed last night in this week's Time magazine there is a little item about Hawaii becoming self-sufficient in energy, and this same tree is mentioned in there. They are going to feed the electricity generators on the island of Kauai with it.

Mr. SCHEUER. It is a source of fuel.

Dr. VIETMEYER. It is a source of fuel and then steam from the boilers turns a turbine and generates electricity.

AID has a program using leucaena in Haiti. Haiti is one of the most deforested countries, almost down to its bedrock, and this tree is growing very well. In fact, AID has millions of seedlings already

produced and from what I hear, the local people are taking them and planting them with gusto.

Therefore, I would like to leave you, Mr. Chairman, with the idea that there are some possibilities here for attacking this deforestation. I would point out that these are not books that just sit on the shelf here in the National Academy of Sciences in Washington. We have produced 20 books now of this style, and we have had requests for over 400,000 of those. They have now been sent to virtually every country in the world. I do not think you could name a country where they could not be found and we make them available—with AID support—we make them available without charge. We are able that way to get them into the hands of everybody from the Prime Minister or the King or the President to missionaries, entrepreneurs, government officials, and students, undergraduate students, all throughout the tropics.

Mr. SCHEUER. Fascinating. I want to go ahead with the other witnesses but let me just ask: Would these trees grow in a dry, hot climate like sub-Saharan Africa, or do they need a very humid, humid environment?

Dr. VIETMEYER. The one I picked and showed you, that sample, really to get that growth you need year-round rainfall and year-round high temperatures.

Mr. SCHEUER. Yes.

Dr. VIETMEYER. However, we have other species for sub-Saharan Africa. One of my colleagues has 80 different species now in trials in different parts of the Sahel, so there are these alternatives. Foresters in the past have been incredibly parochial in the choice of species. You get pines and you get eucalyptus, and not a great deal beyond that. These trees that we are looking at are in many cases not the kind of thing that foresters have paid much attention to in the past.

For example, this is another one. This is called calliandra. It never gets bigger than that. This is its maximum diameter. It is not of interest for foresters, but this will reach twice the height of this room in a year. It is growing up now over tens of thousands of hectares in Indonesia. The peasants cut it down and a year later it is 20 feet or more again.

Mr. SCHEUER. What do you use that wood for?

Dr. VIETMEYER. This is fuel.

Mr. SCHEUER. Fuel?

Dr. VIETMEYER. You see, for a village cookstove, for a household cookstove, this is what you want. They do not have wedges and axes and sledgehammers and the things to handle anything much bigger than that, so this is a perfect size.

[The prepared statement of Dr. Vietmeyer follows:]

Testimony concerning Reforestation
of the Tropics

by

Dr. Noel D. Vietmeyer

Before the

Joint Hearing on Deforestation: Environmental Impact
and Research Needs

Subcommittee on natural Resources,
Agriculture Research, and Environment
of the
Committee on Science and Technology
and the
Subcommittee on Human Rights and International Organizations
of the
Committee on Foreign Affairs

September 16, 1982

Prepared Statement of Noel D. Vietmeyer

Thank you very much for this opportunity, Mr. Chairman and members of the subcommittees. I am Noel Vietmeyer and I'm here testifying on my own behalf. my Testimony, however, is based on studies I've been involved with in my job as Professional Associate at the National Academy of Sciences.

Our program at the NAS seeks out innovations that can help solve problems of developing lands. For several years now we have been exploring ways to slow down tropical deforestation. The result has been a series of NAS reports:

Innovations in Tropical Reforestation

I Leucaena: Promising Forage and Tree Crop for the Tropics
II Firewood Crops: Shrub and Tree Species for Energy Production
III Sowing Forests from the Air
IV Mangium and other Acacias (In preparation)
V Calliandra (In preparation)
VI Casuarinas (In preparation)
VII Leucaena (In preparation)
VIII More Shrub and Tree Species for Energy Production (In preparation)

Information on promising fast-growing trees is also contained in our book Tropical Legumes: Resources for the Future.

I have supplied the subcommittees' staffs with copies of the reports already in print and we will send the others as they come available over the next year.

These books contain information we gathered from almost 1,000 plant scientists in more than 80 nations. Support for this giant effort has come largely from AID's Bureau for Science and Technology.

Between them, these books identify dozens of species of tropical trees that can provide fuel and wood products that today often come from the remaining remnants of the original forest. These little-known species are suited to be "shock troops" for the war on deforestation. They are rough, rugged trees that may not be the most desirable for formal forestry, but they can create a bridgehead by retaking land that was once forest but is now barren or lost to hostile weedy grasses. By providing the tropics with wood for fuel and other uses these vigorous, fast-growing trees can help protect the fragile remains of the original forest. Also most of the species we describe are able to fix nitrogen from the air and thus they manufacture their own nitrogenous fertilizer which gives them a competitive edge.

One report deals with a little-known reforestation technique that sprays tree seed out of planes or helicopters. When species, sites and seasons are favorable this method can initiate tree growth over thousands of acres a day. Aerial seeding was developed by U.S. foresters and has been surprisingly widely used in the South but its greatest promise lies ahead and in the tropics.

Mr. Chairman, these days the NAS is complimenting up its studies of obscure plants by looking into tropical forest animal resources. Our first animal book deals with the water buffalo and I've given copies of it to your staff. Already, the water buffalo is being tested on farms in Florida ad louisiana and it is performing extremely well. It is showing a capacity to thrive on unimproved pastures and even swamp grasses and weeds like water hyacinth.

In addition, we are also investigating the promise of even less well known tropical animals. Few westerners have ever heard of banteng, gayals, gaurs, kouprey or anoas and yet these are cattle-like animals that are native to the lowland tropics of Asia and are so adapted to tree-covered areas that they might provide the basis for an animal agriculture that doesn't demand devastating the forest. Papua New Guinea is one country that is leading the way in domesticating forest animals. It has forest farms raising crocodiles, butterflies, deer, wallabies, and some indigenous flightless birds. At the NAS we are evaluating the unusual animals as well as the principles behind some of the Papua New Guinea farms. In particular we are assessing their applicability to tropical forest organisms elsewhere.

These topics may seem exotic but they are technically sound and they all deserve much greater recognition and support. AID helps to spread the message about these innovation far and wide by providing the NAS with funding that allows these reports to be distributed throughout the tropical world. The response has been overwhelming. Requests for over 400,000 copies of our books have come in from people ranging from heads of state to missionaries and university students. The books give hope, they challenge the readers, they give contacts from which seeds and information can be gained, and thus they play a role in encouraging reforestation.

Some of "our" species, such as leucaena are now being tested in scores of countries and over thousands of acres. Leucaena has actually sparked the personal attention of several national leaders. Mrs. Marcos calls it giant ipil-ipil and she has planted it all over Manila. (I also understand that the Philippine exhibit at the World's Fair in Knoxville features this tree.) Mrs. Gandhi calls the tree kubabul and she is promoting its cultivation in barren, deforested areas of India. This weeks issue of Time notes that the State of Hawaii plans to grow leucaena to fuel electricity generators on the island of Kauai. And leucaena has proven to be one of the few trees to grow well on Haiti's deforested skeleton; AID now has a project there producing millions of seedlings and the local people are, I'm told, planting them with gusto.

Mr. Chairman, rather than go into the details of these wondrous resources I would like to submit the rest of my text for the record and show you a few samples and present you a few highlights extemporaneously.

For OTA I have written two reviews of parts of this work. One of them appears in an 1981 report prepared for the Committee on Foreign Affairs entitled Background Papers for Innovative Biological Technologies

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for Lesser Developed Countries, pages 485-511. The other is in a report OTA is now preparing on issues in tropical deforestation. From these two reviews I have extracted the following statements relating to nitrogen fixing trees and farming tropical wildlife. More details can be obtained from the original texts. My statement concludes with some details of aerial sowing of forests.

Nitrogen-Fixing Trees

Man has purportedly deforested one-third of South America's native forests, one half of Africa's and two-thirds of Southeast Asia's. It is critically urgent that the remaining forest cover be protected from indiscriminate harvest and that many now-deforested regions be reforested. A "thin green line" of fast-growing leguminous trees may be either our last line of defence or our first line of attack.

To most people legumes are limited to the dining table, but to plant scientists legumes include not only vegetables but shrubs, vines and thousands of tree species, most of them indigenous to the tropics. Actually, the family Leguminosae is the third largest in the plant kingdom. But out of the 18,000 different species of legumes, farmers extensively cultivate only about 20 species including peas, beans, soybeans, peanuts, clover, alfalfa, and even licorice. Foresters cultivate almost none.

The potential of tree legumes as useful plantation species remains largely unrecognized, yet they offer a particularly promising area for exploration in these days of devastating deforestation. Indeed, they seem to have special attributes that could put them in the front lines of the battle to reclothe the scarred hillsides throughout the tropics.

Legumes, for example, are nature's pioneers in plant succession. they are among the first plans to colonize bare land. It therefore seems ecologically wise for man to deliberately exploit them for the same purpose: to quickly revegetate eroding or weed-smothered terrain, to halt erosion, and to provide protective ground cover under which slow-growing, climax-forest species can regenerate. Furthermore, many wood requirements might be met by these quick-growing small trees; and this could help spare the last remnants of the natural forests.

Many woody legumes have a hardy, irrepressible character, suited to a wide range of soils, climates, altitudes and envrionments. Like other pioneer species, they have a precocious nature and grow quickly in an attempt to overtop and preempt the space of their plant competitors.

Because of this innate competitiveness, many tree legumes are easy to establish and cultivate. some can be direct-seeded (avoiding the expense of nurseries and of transplanting fragile seedlings), and in some tests even spraying their seed out of aircraft has proven a suitable way to establish plantations. Many occur naturally in dense, pure stands, suggesting that they probably can be grown in monoculture without being decimated by pests.

A most important feature of many legume species is that nodules on their roots contain bacteria, which chemically convert nitrogen gas from the air into soluble compounds that the plant can absorb and utilize. Thus, for average growth these species require little or no additional nitrogenous fertilizer. Some produce such a surfeit of nitrogen--largely in the form of protein in their foliage--that they make excellent forage crops and the soil around them becomes nitrogen rich through the decay of fallen foliage.

In order to give an idea of the potential of this class of trees, three species of fast-growing legumes are mentioned below. Not one of these trees is widely exploited so far.

Leucaena

In the 1960's, University of Hawaii professor James Brewbaker found in the hinterland of Mexico certain varieties of Leucaena leucocephala that grow into tall trees. This was unexpected because the plant was previously known only as a weedy bush.

But in tropical climates Brewbaker's varieties have grown so tall and fast that they can be twice the height of a man in just six months; as high as a three-story building in two years; and as tall as a six-story building with a trunk cross-section as large as a frying pan in only six or eight years.

In the Philippines one hectare of these tall leucaenas has annually produced over 10 times the amount of wood per acre that a well managed pine plantation produces in the United States. Even among the world's champion fast-growing trees, this is exceptional.

Leucaena wood is thin barked and light colored. For such a fast growing species, it is remarkably dense (comparable to oak, ash, or birch), strong, and attractive. Its fiber is acceptable for paper-making and the wood can be pulped satisfactorily and in high yield.

But leucaena, a multipurpose plant par excellence, also has other uses. It can supply forage, for example, and researchers in Hawaii and tropical Australia have found that cattle feeding on leucaena foliage may show weight gains comparable to those of cattle feeding on the best pastures anywhere. Also leucaena wood makes excellent firewood and charcoal. The plant is also a living fertilizer factory for if its nitrogen-rich foliage is harvested and placed around nearby crop plants they can respond with yield increases approaching those effected by commercial fertilizer.

Although arboreal leucaena varieties have been cultivated for only a decade or so, they are already being planted over tens of thousands of hectares in the Philippines. The World Bank has funded one large program. Bantangas Province has a nursery producing 10,000 leucaena seedlings daily. The province's dynamic governor, Antonio E. Leviste, has decreed that other nurseries be set up throughout his province: in churchyards, cemeteries, schoolgrounds, roadsides--any idle ground. No government employee gets a paycheck until he has set up a leucaena

plantation with at least 20 trees to produce seed. The consequent greening of Batangas has made citizens keenly appreciative of deforestation's ugliness and problems, as well as reforestation's rewards. Tree planting now interests the Batangas public intensely--not entirely for the sake of revegetating eroding watersheds, but for the income and benefits from exploiting leucaena forage, fuelwood, and "green manure." That the program has been adopted with gusto by the citizenry demonstrates the releveance of tree legumes to tropical problems as a sort of "appropriate forestry."

In more remote southern islands of the Philippines, leucaena (Filipinos call it ipil-ipil) is being planted over huge areas of former green-deserts, wastelands lost to coarse, sharp-edged "cutting-grasses." With its vigor and persistence, leucaena--if given a little care--an overtop the grasses, shading them out of existence, and converting waste ground to highly productive forest. It is essentially a permanent forest because after felling, the stump of a leucaena tree regrows with such vigor that the plant is said to literally "defy the woodcutter."

Calliandra calothyrsus

In 1936 horticulturists transported seed of this small Central American tree to Indonesia. They were interested in it as an ornamental, for like other Calliandra species, it has flowers that are gorgeous crimson powderpuffs, flowing in the sunlight like red fireballs. But Indonesians instead took up Calliandra calothyrus as a firewood crop. Indeed, for 25 years steadily expanding fuelwood plantations of it have been established until they now cover over 75,000 acres in Java.

This small tree--barely taller than a bush--grows with almost incredible speed. After just one year it can be harvested. The cut stump resprouts readily giving new stems that can be 10 feet tall within six months. Some trees in Indonesia that are 15 years old have been harvested 15 times!

Calliandra wood is too small for lumber, but it is dense, burns well, and is ideally sized for domesic cooking. It is also useful for kilns making bricks, tiles, or lime and for fueling copra and tobacco dryers.

Indonesian villagers now cultivate calliandra widely on their own land, often intercropping it with food crops. The plant's value is dramatically exemplified by the village of Toyomarto in East Java. There, land that was once grossly denuded and erosion-pocked is now covered with calliandra forest and is fertile once more. Today the villagers actually earn more from selling calliandra firewood than from their food crops.

Conclusion

These are brief descriptions of only two species of small leguminous trees that have recently proven useful in combating deforestation in Southeast Asia. There are many other exciting species. In South Korea, foresters intercrop bushy Lespedeza species to provide firewood during

the early years of the establishment of pine and other forests. In Central America, there are Enterolobium cyclocarpum and Schizolobium parahyba, in South America, Mimosa scabrella (M. bracatinga), Schizolobium amazonicum, Tipuana tipu, and Clitoria racemosa; and in the Pacific Islands, Albizia minahassae and Archidendron oblongum. In Africa, several fast-growing Albizia (A. adianthifolia, and A. zygia, for example) are indigenous, and two legume trees introduced from India, Acrocarpus fraxinifolius and Dalbergia sissoo, have shown exceptional growth rates on appropriate sites. In Asia there are also Acacia auriculiformis and Sesbania grandiflora.

In foresters' terms many of these species have "poor form'. Their trunks may be too narrow or too crooked for construction timber or veneer. But, these are species for "peoples' forestry." Their role is for:

- Farms, backyards, pasture lands, roadsides, canal banks and fencelines;
- Village woodlots and energy planttions to fuel kilns, electricity generators, cooking stoves, and crop dryers;
- Agrisilviculture (agroforestry), because they provide a wealth of products including forage, green manure, and food;
- Use in shifting cultivation, because the natural drop of protein-rich leaves pods and twigs contributes nitrogen organic matter and minerals to upper soil layers and can markedly speed up the rebuliding of warn out soils;
- Quick-rotation cash crops, both for the private landowner and the government forest department; and
- Utility purposes such as beautification, shade, and shelter belts.

Farming Tropical Wildlife

The livestock species the world depends on today are, unfortunately, all best adapted to temperate conditions, to open pasture land, and to grazing. That is because Stone Age man in what is today Europe and the Middle East took into his hands the prototypes of agricultural animals that were available to him. Cattle, sheep and horses, for example, cannot be raised efficiently in the tropical forest. In fact pastoralism is a major contributor to tropical deforestation. Ranchers cut and burn trees, pull stumps and seed the land with grasses because that is the kind of environment cattle, sheep and horses need.

It is often claimed that economic development is necessarily destructive to the environment and detrimental to conservation--that as rural societies develop, their natural surroundings must automatically suffer. But that is not necessarily so. Careful farming of indigenous wildlife, as opposed to conventional livestock, offers the possibility of enhancing the value of tropical ecosystems and thus provide the incentives to sustain the now threatened forests and woodlands.

Already the government of Papua New Guinea has several projects (see below) that help conserve tropical forests and swamplands by raising animals that live naturally in those habitats: crocodiles, butterflies, wallabies, megapodes, cassowaries and deer. This contrasts with the normal process felling the forests and draining the swamps so as to suit the peculiar needs of cattle or sheep.

Indigenous animals are often more efficient meat suppliers than domestic livestock. They better withstand the local environment, they thrive on local vegetation, they tend to be more resistant to local diseases, and they are generally less destructive of the environment. In addition, indigenous animals sometimes provide better food. In Ghana, for example, the meat of the grasscutter (Thryonomys species) and giant rat (Cricetomys species) has been determined to be more nutritious than pork or mutton. And Africans consider the meat of these two rodents to be delicious. (Americans once relished squirrel for the some reason.)

In East Africa it has been found that wild animals such as the antelope, eland, gazelle and gnu are paragons of efficiency. They need one-quarter the water required by cattle; they make use of all the plant life; they have inbred disease resistance; and they are prolific. Thomson's gazelle, for example, requires a mere 44 weeks from the birth of one set of offspring to the next. The development of such animal resources could bring important benefits to woodlands or forests. And Brazil is finding that water buffalo are far better adapted to swampy lowlands of the Amazon region than cattle. Using the buffalo then means less drainage of wetlands and thus more preservation of the original habitat.

In fact, it may be possible in some areas to harvest more meat from forest and woodland animals than from conventional livestock. Cattle, for example, do not fare well in the tropics. They require large amounts of water and forage; they are prone to diseases and parasites; and they breed slowly--taking as much as two years between calving.

Papua New Guinea's Wildlife Farms.

As noted already, the Papua New Guinea government has a remarkable attitude towards farming its indigenous animals. To take advantage of its biological resources, Papua New Guinea has set up farms to domesticate, propagate and utilize the following wildlife.

CASSOWARIES. Large birds (only ostriches and emus are larger) with iridescent red and purple necks, naked blue heads, and huge green eggs, cassowaries are so valued in PNG that a large one can cost $400. They are important for feasts, dowries, and the repayment of debts. The feathers are used in headdresses, the flesh of the thigh muscles resembles beef. already a farm for up to 500 cassowaries has been established at Mendi. Husbandry practices are being optimized and staff trained so that cassowary raising can be extended throughout the western and highland districts.

MEGAPODES. One of the most exotic and intriguing birds, the megapode gathers in large numbers to lay eggs in the hot sands near Mt. Tovarvar, a simmering volcano on the island of New Britain. The megapode's beak has a "thermometer" and the bird digs until it locates sand that is exactly 91°F, before it lays its pink eggs to incubate. Each year the villagers dig up about 20,000 eggs, which are an important source of protein and cash income for the villages. The government is now controlling the harvest to ensure the survival of the species and the continued productivity of the egg-grounds.

WALLABIES. For Papuans, the agile and bush wallabies are the second largest source of protein (after fish). Wallaby domestication is now being attempted at the University Farm in Lae. Research into wallaby conservation, nutrition, reproduction, health and husbandry is beginning. Pilot-sized wallaby farms have been started in the Milne Bay and Northern Districts.

DEER. In the Western District the husbandry and rational exploitation of the elk-sized, sambar deer is being attempted.

BUTTERFLIES. Collectors will pay hundreds of dollars for specimens of PNG's rare birdwing butterflies (Ornithoptera spp). The man-in-the-street will pay several dollars for these brilliantly colored decorative organisms. Ounce for ounce butterflies are worth more than cattle.

Farming butterflies seems like an exotic and unlikely industry, but to some Papua New Guineans it is becoming almost routine. More than 500 villagers in provinces are rearing or collecting butterflies, beetles, and other insects for export. The government now considers insects a national resource and Papua New Guinea is the only country in the world to specify insect conservation as a national objecive in its constitution. It has established an insect farming and trading agency at Bulolo to handle the business details of a growing international trade.

Insect farming is seen as a lucrative industry for all districts. Unlike cattle raising, it needs no fences, no tree clearing, no change in lifestyle, no worry about loans or disease. In a sense butterflies are an "appropriate" livestock, particularly for remote, rural tropical areas were other forms of income are difficult to institute or are harmful to traditional lifestyles or to fragile environments. To villagers it is cattle that are an exotic and unlikely resources.

CROCODILES. Near Port Moresby there is a government crocodile farm with 3000 head. It is used for training technicians who then go to villages to set up farming there.

Crocodile production is now an established industry in Papua New Guinea, bringing in excess of $4 million in foreign exchange each year. Papua New Guinea's crocodile farming program aims to conserve crocodiles so that village people can enjoy the benefits of this resource. It has become the underpinning for the economic improvement of some of the poorest of the earth's people. It has also increased the country's earnings in foreign exchange and established crocodiles as a significant national asset.

RESULTS. Papua New Guinea's wildlife farming programs demonstrate that with suitable organisms and techniques, natural resources can be made profitable in such a way as to protect the natural environment. Most of Papua New Guinea is still covered by primary rainforest. Exploiting the economic value of its organisms is helping safeguard this increasingly rare habitat that is fast disappearing in most parts of the tropics.

Aerial Forestry

In some countries farmers plant rice, soybeans, clover, and other crops by spraying seed out of airplanes or helicopters. Now a few foresters have learned that trees can be planted the same way.

Aerial sowing might provide a practical way to restore tree cover to the vast deforested areas of the world. When season, soil and species are right huge areas can be reforested quickly and easily using aerial sowing. In good weather and on favorable sites (for example, with landing sites close by) a helicopter can seed 7,500 acres a day.

"If it can be developed for sites and objectives in developing countries." says the NAS report, "aerial seeding could offer opportunities for vastly accelerating their reforestation programs."

The idea is untested except in Australia, Canada, New Zealand, and the United States where each year pines, eucalypts and other trees are sown from aircraft over tens of thousands of acres. In the South, during the last 20 years more than 2.5 million acres of pines have been sown, most of them from the air.

Aerial seeding is particularly suited to reforesting sites whose remoteness, ruggedness, inaccessibility or sparse population make the conventional planting of tree seedlings difficult. It can be deployed rapidly, which makes it useful for use after forest fires, hurricanes, volcanic eruption or other catastrophe.

The technique is not a panacea, however, and it is best seen as a complement to conventional planting; an additional tool for foresters to use when the needs, sites and species are appropriate.

The major problem is the vulnerability of the seeds sitting exposed on the bare soil. Birds, insects, and rodents are likely to carry them off. Also the trees don't get as good a start in life as those transplanted as seedlings. They may succumb more readily to drought or other stress.

Nevertheless, chemicals and techniques that help overcome these problems are now available and aerial seeding can, on appropriate sites, enable rapid reforestation with less organization, less infrastructure, and less capital investment than is now possible.

UNDEREXPLOITED PLANT AND ANIMAL RESOURCES FOR DEVELOPING COUNTRY AGRICULTURE

Dr. Noel Vietmeyer
Board on Science and Technology
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UNDEREXPLOITED PLANT AND ANIMAL

RESOURCES FOR DEVELOPING COUNTRY AGRICULTURE

The 1940s was the decade of wonder chemicals. The miraculous properties of DDT, sulfa drugs, herbicides, nylon and plastics blinded us to the potentials of nature. Laboratories were limitless, nature seemed limited. Man-made was modern, nature seemed passé. Subsequent decades seemed to confirm the euphoric view; we gave up seeking our new product needs in the kingdom of nature, the previous wellspring for civilization's advances.

As a result, as we move toward the 21st century, we rely on fewer and fewer plants and animals. We ignore, or have forgotten, thousands of useful species that could broaden and balance our fount of resources. All this, in face of the recognition that within a few short decades the petrochemical explosion that began in the 1940s will be snuffed out.

However, there is now a big change occuring in the scientific community. Researchers are returning to nature's storehouse to take stock of its genetic possibilities; to scrutinize species that could make useful new crops and domestic animals--some of them are species that are wild and

untested, some even poorly identified. Though they work largely out of the public eye, these dedicated researchers are quietly germinating ideas and laying roots that will grow with and shape our future. Some natural products now virtually unknown are likely to become mainstays of world agriculture.

Decision makers, entrepreneurs and the general public should pay more attention to these researchers' results. A groundswell of support for the development of new species could lead to a cornucopia of new foods fuels and industrial feedstocks. It may help extend productive agriculture to vast regions that today are not arable. It may help raise from despair the ever increasing numbers of humans in developing countries who waste their lives away in malnourished poverty. It may show how to cultivate crops that produce raw materials that now come from petroleum. It's a challenge. But some of the future's best resources are out there waiting in the land of nature.

ANIMALS

When early farmers discovered that animals could be tamed and managed, they eagerly experimented with many of the species surrounding them. In Asia and the Americas, the silkworm, yak, camel, water buffalo, llama, alpaca and guinea pig were selected. Egyptian tomb paintings at Saqqara painted in 2500 BC show addax, ibex, oryx and gazelle wearing collars and obviously domesticated. Ancient Egyptians apparently domesticated hyenas and baboons, as well.

But then the process essentially stopped. Today's farmers raise the same animals their Neolithic forebears were familiar with more than 10,000 years ago. (One exception is the rabbit, which French monks tamed between

the 6th and 10th centuries because the Church considered newborn rabbits to be fish and they could be eaten when the Church calendar demanded abstinence from meat.) Although the world's menagerie contains some 4,000 species of mammals alone, only a mere six domestic animals produce virtually all of the world's meat and milk.

As agricultural man spread himself about the globe, he dragged with him this handful of species. He carried them beyond their natural boundaries, forced them upon strange and often fragile environments---usually driving out the native species that previously predominated there, and often drastically changed the environments to accommodate them.

Very little meat is eaten in developing countries and because most of them are in the tropics, it is not possible to change that much with cattle, sheep and pigs that have an evolutionary adaptation to the temperate environments from which they originated and are limited in their ability to adapt to new ones. But the world's fauna is a rich genetic bank that may be tapped to increase world food production. Some of the potential species are unexpected ones, as highlighted below.

Toads, Snails and Guinea Pigs

In rural areas of developing countries, it is important to produce small animals. They fit better into village life and if they can be eaten at one meal, then the lack of refrigeration is no hindrance. In Chile, there's a shiny, olive green toad (Calyptocephalella caudiverbera). It is a giant toad that can weigh three pounds or more. Its meat tastes like a cross

between lobster and chicken. It grows to be a foot long or more and lacks the toxic skin glands and warty appearance of other toads. Because of its superb and enigmatic taste, the wild toad has long been a delicacy of Chilean gourmets. But now, researchers at the La Serena campus of the University of Chile are learning how to farm them.

In 1975, the University's Institute of Food Technology started farms large enough to porduce 100,000 of the choice toads every two years. The intensive methods they developed have made it feasible to supply 10 to 15 tons of scallop-sized toad legs each year to grocery stores, restaurants and canneries.

The institute also has dug production ponds out of otherwise useless swampland. The eggs, larvae, tadpoles and adults are all kept apart because the voracious toads have no hesitations about cannibalism. Normally, however, they feed on small fish, crabs, crawfish and aquatic plants. The ponds are surrounded with flowers and shrubs to attract insects and boxes of rotten fruit are placed nearby to draw fruit flies to the area. With their long sticky tongues, the toads eagerly capture the insects. Other than this, the toads reportedly are given little attention and in 2 years they reach market size: about 7 inches long and weighing ½ lb.

Researchers are ecstatic over the ease and cheapness of toad farming, and they are looking toward the lucrative international frog meat market to export the tender, white drumsticks of these unique Chilean toads.

The Chilean toad is an example of a potentially valuable new resource for developing countries. In Nigeria, the Institute of Oil Palm Research is developing another one: the giant African Land snail (Achatina species).

This snail grows rapidly and may weigh up to half a pound. It is eaten widely in West Africa and is immensely popular in parts of Nigeria and Ghana. The meat has as much protein as beef, but it has considerably more of the important amino acids, lysine and arginine, than even eggs contain. The Institute has found the snails suitable for "farming" in shaded enclosures under the trees in rubber, cocoa or oil-palm plantations. With proper proportions of males and females, it has produced as much as 150 lbs of snail meat in the small enclosures each year.

In Peru scientists are looking to their indigenous fauna, too. One of Peru's serious and permanent problems is a lack of beef. Two-thirds of the steaks of which Peruvians are so fond, are imported despite the nation's chronic dollar shortage. The situation became so serious that five years ago the military junta put a ban on beef consumption 15 days in every month. Chicken production was once believed to be the answer to the problem, but although it has grown fast, so has the population. Big hopes were placed on fish too, but the country lacks the financial resources to install the facilities needed for national marketing. The guinea pig is now believed to be the best answer so far to the problem posed by the short supply of proteins of animal origin.

Guinea pig is a traditional staple. Although domesticated in the time of the Inca, it has not previously attracted much research attention. Yet guinea pig is widely consumed in Peru. The nutritional value of it's meat compares favorably with that of other meats. The animals can be raised in urban areas and in villages, where larger animals are scarce or impossible to keep. The fast growth, and rapid reproduction, makes the guinea pig

a sensible resource in the Peruvian environment. Added to this is the fact that guinea pigs can live off vegetation that is of inadequate nutritive value for feeding other livestock.

These resources are strange--even repugnant--to the majority of specialists working to increase food production and improve human nutrition in developing countries. But to the local inhabitants they are traditional foods that are much sought and enjoyed.

Crocodiles

In Africa, South and Southeast Asia, Australia and South America, the populations of crocodiles, alligators and caimans are fast headed for extinction. In Papua New Guinea in the 1960s, the two native crocodile species were headed the same way. But not today. In the last five years, a remarkably innovative project in this, one of the newest and most underdeveloped nations, has caused a dramatic turnaround in the crocodile's drastic decline there. Though the P.N.G. story has not been told widely, it is one with immense implications for the survival of crocodilians elsewhere. It is also a demonstration of how resources can be managed to conserve a species, to minimize impact on a fragile environment, and to provide wealth in remote villages in a developing country.

The P.N.G. program is based on an appreciation for crocodile biology. Each year, a female may lay between 30 and 70 eggs, but though most of them hatch, predators so relish the tender and remarkably vulnerable young hatchlings that almost none survived the 15 years needed to reach breeding size. In nature, then, there can at any time be found a plethora of tiny crocodiles, but a paucity of breeders. Commercial hunting worsens the imbalance because

hunters always seek the biggest specimens, irregardless of the resulting damage to the breeding populations.

Recognizing that a ban on hunting would be largely unenforceable in remote areas (and grossly unpopular where man-eaters sometimes occur), the P.N.G. Government decided in 1970 to restructure the trade so that shooting breeders would lose its attraction and the profit would come from exploiting the hordes of tiny hatchlings that would result. This was done through a law banning the sale of large skins, supplemented by a stiff tariff on small skins.

Today, villagers in the steamy swamps of P.N.G. have tens of thousands of tiny crocodiles in their care. They raise them for a year or two and can sell them for up to $100, each. Crocodile farming has already become the main cash earner for the people there. I personally met a village leader in Wewak who had come to oversee shipment of $14,000 worth of skins headed to New York by airfreight.

The P.N.G. crocodile project is characterized by:

Good Science. Despite popular "man-eater" impression, crocodiles live mainly on fish, though the researchers in P.N.G. have found that young ones also grow well on frogs, snails and beetles. The feeding efficiency is astounding: 1½ lbs of food gives 1 lb of weight gain, and foot-long animals can grow to be 5 and six feet long in less than 2 years. (Conventional domestic livestock require 5 to 8 lbs of food to produce 1 lb of weight gain.) Crocodile farming is also space efficient: dozens of animals are raised in an area the size of a household living room ; in a swamp or jungle, that's important.

Good Conservation. Because the program is based on harvesting young hatchlings from the wild, the economic value of the wild populations and their habitats becomes forcefully apparent. The program's future depends on them. It gives economic value to wildlife protection. Out of pure self-interest, the people become guardians and conservers of habitats and wildlife. In a sense, the farming project is just a tool for conserving the species in its own wild habitat.

Good Sociology. The villagers have a sophisticated knowledge of the crocodile; the animal is part of their culture and heritage. They don't have to be taught how or where to catch crocodiles, and they take quickly to the program. Introducing cattle or Western-style crop-raising would require massive and tedious education and training.

Good Environmental Management. The program is based on living with the existing landscape and resources. It requires none of the bush-clearing fencing, forage-grass planting or pesticide spraying that rearing other domestic animals would demand. That's important in a fragile tropical rainforest ecosystem.

Good Economic Development. What other agricultural product could give a $14,000 income in a remote jungle village?

Butterflies

In remote jungle towns in the north of Papua New Guinea are operating butterfly farms; some of the most unusual farms in the world.

Around the edge of a field are planted flowering shrubs to attract the adult butterflies whose mouthparts are adapted for drinking nectar from

flowers. These butterfly "forages" include hibiscus, flame-of-the-forest and the strange, pipe-like aristolochia. Within half-acre circlets of these flowers are planted leafy plants that the caterpillars feed on. The combination provides a complete habitat where butterflies find everything they need for their life cycle. Thus few leave, and the farmer retains his livestock without fencing or walls.

Butterflies may seem exotic livestock to us, but even in the remotest P.N.G. jungle, a villager knows and understands their habits, location and lifestyle. And butterflies don't require bank loans, veterinary services, artificial insemination or the other impedimenta of the conventional livestock. Also, when farming insects, the villager can work when and if he wants to: there are no deadlines. No hard labor and no danger, either. To a Papua New Guinean, the strange thing is that people are willing to pay for a butterfly.

And pay well they do. Ounce for ounce, exotic butterflies are far more valuable than cattle. And worldwide demand for butterflies is rising. Millions are caught each year and sold to museums, entomologists, private collectors, and perhaps most of all; to ordinary citizens. The fragile, iridescent creatures, mounted in plastic, decorate purses, trays, tabletops, screens and other ornamental objects.

With their butterfly farms many rural Papua New Guineans are for the first time participating in a cash economy and butterflies are beginning to improve the welfare of many villages. At Bulolo, the government has established an insect-buying agency to help the butterfly farmers of Papua New Guinea. It purchases insects from farmers and fills specific orders requested by overseas buyers. Profits go to the villager.

Perhaps the most striking feature of the program is that it is actually conserving, and even increasing, the numbers of butterflies. Basically, it is an exciting, pioneering conservation project because it develops a tremendous economic incentive to preserve populations and habitats--the program relies on healthy wild populations to keep the farms stocked.

Because of this, conservation organizations are becoming excited by the program, seeing in it a model that could be duplicated to help save endangered exotic butterflies everywhere.

Mr. SCHEUER. Phenomenal. Thank you very, very much, Dr. Vietmeyer.

All right, Mr. Bruce Ross-Sheriff.

STATEMENT OF BRUCE ROSS-SHERIFF, PROJECT DIRECTOR, FOOD AND RENEWABLE RESOURCES PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. ROSS-SHERIFF. Thank you, Mr. Chairman.

At least in the circles I travel in, Dr. Vietmeyer is the hardest act in town to follow, but I will do my best.

Mr. SCHEUER. I sympathize with you.

Mr. ROSS-SHERIFF. Thank you for inviting OTA to testify today on our assessment of technologies to sustain tropical forest resources. The assessment was requested by the House Foreign Affairs Committee, and we have expanded the scope of work to meet the needs of the Senate Energy and Natural Resources Committee.

We have commissioned some 35 technical papers from experts all over the world. We have received those and are in the process of getting review comments on them. In about 3 months, our analysis of various ways to make tropical forest resource use systems sustainable and of actions that Congress can take to that end will be completed.

The bottom line in OTA reports is our assessment of options for Congress and our analysis of the likely outcome of those options take. In this assessment we intend to use a systems model effort in which one of the main causal variables will be population growth. We are very much aware of the fact that sustaining the resources is something that can only be done under population constraints.

Our draft report should be sent to the Technology Assessment Board in April and then published. The staffs of both of these committees, have been in frequent contact with us and this is an important part of our assessment process. My written testimony today only gives some preliminary assessment findings.

Trying to be brief, I will skip over my written testimony on the data base. I think Mr. Long has already covered that in his summary. When I was at a different agency, I was the analyst assigned to write the Global 2000 Report chapter on tropical forests and worked quite a lot with the data base that was available in the late seventies.

The data base we have now, thanks to UNEP and the Global Environmental Monitoring System reports, is much better. It is like a snapshot from space: It is global in scope, it shows only one point in time, it is not detailed enough, but it is a lot better than we had a few years ago. With the current data, we will be able to provide Congress with a much better assessment of what is happening and of the likely consequences of congressional options actions Congress can take than we could have done without that important information from the UNEP program.

Mr. Long mentioned the deforestation figures. I will not go over those again except to help you visualize the problem by noting that the area of annual net forest reduction in the tropics, according to the UNEP data, is about equal to the size of Pennsylvania.

A pertinent question for these hearings is: what are the data that we need, but do not yet have for policy analysis of the type that OTA does? There is much too little data on how resources are being changed in the areas that remain classified as forests. We know something now about the net reduction in forest; we know very little, still, about what is happening to the areas still called forest.

Our projections for policy analysis are or will be somewhat doubtful because we do not even know whether the deforestation rates are accelerating or decelerating. We have very little information on how causes interact—causes such as population growth, urbanization, agricultural productivity, logging practices, and so forth. Very little progress has been made in documenting the consequences of deforestation in ways to convince policymakers in the tropical nations that they should enforce forest resource policies.

Bill Long's testimony mentions that environmental education is one of the major thrusts for the State Department's environmental activity and for AID. The State Department has among its tools the rapid computer program—you may have seen it—which relates population growth to environmental degradation and to deforestation. This is taken out to the less-developed countries and used to convince top-level policymakers of the relationship between population growth and deforestation. That is among the technologies that AID is working with in environmental education at which we will be looking.

Mr. SCHEUER. What do you call that system?

Mr. ROSS-SHERIFF. I believe it is called the rapid computer system in AID. It uses a minicomputer that they can put in a suitcase and take it directly to whatever high-level government people to whom they have access.

The information that has been compiled so far for OTA suggests that social and economic factors are both the major causes of deforestation and the major constraints to forest management and reforestation. Thus, the first need for research is in the social sciences: anthropology, sociology, economics, and education. Unfortunately, most of the specialists working on tropical forest issues are natural scientists. In fact, most of the environmental educators are natural scientists. They do not have the training to adequately understand the socioeconomic dynamics that cause tropical forest resource use systems to succeed or fail. The need for more social science field work and more technical analysis in social science as it relates to natural resources in the tropics is universally recognized by all the tropical forest experts that we have been contacting, but very, very few of those tropical forest experts have the background to do that work.

In stressing the social and economic constraints, I do not want to imply that technologies that can be used to sustain tropical forest resource systems are already developed, on the shelf, awaiting resolution of the socioeconomic constraints. In fact, we have learned of no management techniques that can produce commercially important quantities of products for use outside the forest and simultaneously sustain the ecological diversity of tropical forests, except the butterfly farms and crocodile farms that Dr. Vietmeyer has called to our attention.

This has led several eminent scientists to conclude that tropical forest resources are nonrenewable. Our assessment indicates, however, that this judgment is premature. There simply has been very little research in which the goal has been to develop management techniques that could sustain the forest in its natural condition while providing substantial products for commerce.

There are several proposals for such research. AID has one study that is beginning, and several of the ideas and proposals from scientists seem based on good science and sound logic.

Technologies do exist to manage cut-over tropical forests. The work to develop such technologies dates back at least to the 19th century, but most of these technologies reflect the goal of colonial governments that sponsored their development—that is, production of industrial wood for export. Forests under such management lose some of their ecological diversity, but at least in theory, at least, they yield increased returns. The problem is that the management systems that are available are seldom, if ever, implemented, and very few efforts are being made to improve the old management systems or to adapt them to site-specific conditions.

One type of tropical forestry where there is some progress is the establishment of forest plantations on previously cleared land, especially on degraded land. Several groups of foresters and biologists concerned about the slow pace of research have made lists of priorities. Mr. Long mentioned the most recent list, which comes from FAO and the World Bank.

The OTA assessment has not yet made a judgment about those lists of priorities or tried to compare which are most important. All the priorities that have been identified by these groups seem necessary. However, it also seems doubtful that these research projects would be sufficient even if they all were implemented.

One of our commissioned papers identifies a structural cause for the insufficiency of tropical forest research. It pertains even in the United States where research issues are simpler and where the research effort is much larger and better organized than in the tropics. It is the problem of technology transfer between researching and practitioners of forestry. Most managers simply do not judge that they have time to search out and read, the information constantly being generated by research.

Each year there are national, regional, and State workshops within the United States held for foresters to acquaint the managers with new findings, yet only a fraction of the managing foresters attend. Technology transfer from U.S. research laboratories to tropical forests presents even greater problems because of the distance, language, and lack of access by tropical foresters to data bases. This seems likely to be a principal technology issue for us. What is the solution? We do not have a conclusion yet but we expect that it will involve a restructuring of the research effort and not merely more money for more research.

OTA staff were invited by one of our advisory panel members, Dr. Norman Johnson of Weyerhaeuser Co., to see how private industry resolves this problem of technology transfer. In North Carolina we interviewed research staff assigned to Weyerhaeuser's forest management programs there. Subsequently we interviewed Dr. Ladrach, the research director for Carton de Colombia, and

other scientists, who confirmed that industry does have a cost-effective way to get the results of research implemented quickly. It is to have a research component associated with each action project. This is not done regularly by AID, the United Nations, the World Bank, or any of the governments of tropical nations.

In summary, the conversion of tropical forest to degraded forest and to nonforest is likely to continue, and indeed it may accelerate with increased populations of landless farmers and improved techniques for razing the forest. Unfortunately, this conversion is not limited to the land that will support agriculture. To slow and halt forest degradation and to reverse the trend so that the productivity of forest resources can be sustained in perpetuity will require new policies and new programs, and these must be based on new knowledge. However, even with increased funding, fundamentally new approaches to research and technology development will be necessary.

[The prepared statement of Mr. Ross-Sheriff follows:]

STATEMENT OF BRUCE A. ROSS-SHERIFF, PROJECT DIRECTOR
OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS

Chairmen and Members of the Committees:

Thank you for inviting the Office of Technology Assessment to testify today. I am Bruce Ross-Sheriff, Director of OTA's assessment of technologies to sustain tropical forest resources. That assessment, which was requested by the House Foreign Affairs Committee and expanded to meet the needs of the Senate Energy and Natural Resources Committee, is now completing the information gathering stage. We have commissioned and received some 35 technical papers and are now receiving review comments on these papers from our advisory panel and from other experts. Our analyses of the various methods for making tropical forest resource systems more sustainable, and of actions Congress may take to that end, will be complete in about three months. Our draft report then will be sent out for review by various specialists. The final report is scheduled to be sent to the Technology Assessment Board in April, 1983, and then be published. The staffs of your subcommittees have been in frequent contact with us and are an important part of this assessment process.

My testimony today presents some preliminary assessment findings. Our final conclusions regarding deforestation and options for possible congressional action will not be available until April. I will first discuss the data base on degradation of tropical forest resources, and then share with you what we have learned about research necessary to cope with the problems of deforestation.

DATA BASE ON REMAINING FORESTS AND DEFORESTATION RATES

U.S. government attention began to focus on loss of tropical forest resources in the late 1970s. The deforestation alarm was sounded mainly by

biologists and economic development specialists. The data base available in 1978 indicated that nearly half of the land[5] in the tropics that had been forest-covered within historical times were now deforested, and that the remaining forests were being converted to other uses and to wasteland at a rate of one to two percent per year. The major impacts of this rapid change were understood to be wood shortages, especially of firewood, loss of genetic resources, and disruption of the forests' modulating effects on hydrology and soil stability, with consequent soil loss, flooding, and damage to agriculture. The oil crises of the 1970s awakened development specialists to the fact that wood is the most important energy source for many lesser-developed nations, an energy source that is rapidly losing its renewability.

Substantial improvements have been made in the data base since the late 1970s. A 1981 U.N. report provides, for the first time, detailed country-by-country data on the extent and status of tropical forests, as well as country-level estimates on deforestation. With these new data, analysts such as those working on the OTA project can produce much more accurate evaluations of the forest resource problems and of the related policy options. Furthermore, the new data will greatly enhance the usefulness of computerized models, which aid in understanding processes ranging from CO_2 concentrations in the atmosphere to economic development and international trade.

However, this new data base is still far from sufficient for planning necessarily site-specific solutions to problems of tropical forest management. We do not know the accuracy of the data--no doubt it is highly variable from country to country. Only for a few countries in Africa do the data come entirely from LANDSAT images. For the other tropical nations the data base is still gathered mostly from older methods of resource inventory, which are less accurate and likely to be out of date.

The U.N. report is based on data from GEMS--the Global Environment Monitoring System--organized under the United Nations Environment Program (UNEP). The forest resources study was done for GEMS by the Forestry Division of the U.N. Food and Agriculture Organization (FAO). UNEP intends to continue the GEMS program in order to include areas and forest types not included in the first report, to enhance the accuracy of the data, to enlarge its scale so that it becomes more useful to specific resource management efforts, and to monitor changes. **Plans to use renewable resources must include projections of how the proposed use will affect the long-term productivity of the resource, but until accurate time-series data are available, those projections will be mostly hypothetical.** Whether the GEMS program will continue and accomplish its important monitoring function, now that it has completed the intial base-line study, depends on the fate of UNEP.

Thus, analysts now have a data base on tropical forest resources that is analogous to a snapshot from space . . . global in scope, showing only one point in time, not providing enough detail, but a lot better than what we had a few years ago. In the tropical zone of the Earth, there are still some twelve million square kilometers of closed forest (i.e., tree canopies cover most of the ground and there is no extensive grass under the trees), and another seven million square kilometers of open forest (i.e., tree canopies cover more than ten percent of the ground, but not enough of the ground to suppress grass between the trees). Deforestation for the whole tropics is estimated to result in net reduction of forest cover by about 113,000 square kilometers per year--75,000 square kilometers of closed forest and 38,000 of open forest. This is the area completely cleared and converted to other uses or to wasteland. We do not yet have such area estimates for the places where the land remains classified as forest but is having its productivity substantially or permanently changed.

For the tropics as a whole, the forested area is decreasing by about six-tenths of one percent per year. Most of that clearing is done to create agricultural land. If this were happening on land that was able to sustain agriculture there would be no major problem. Unfortunately, that is not the case. Rather, the deforestation is concentrated in countries and regions where populations are most dense and where the land that can be used for agriculture over a long period of time has already been developed. Thus, in tropical America the new data indicate that Mexico, the countries of Central America, Colombia, Ecuador, and Paraguay all have deforestation rates of more than one percent per year. Finally, there are nations such as Haiti and El Salvador where the annual acreage of deforestation is low because almost all of the forest is already gone.

Across the Atlantic, deforestation is most severe in West Africa, where four percent of the closed forest is cleared each year, in densely populated Brundi and Rwanda, where three percent of the forest is lost each year, and in Madagascar, with a 1.6 percent deforestation rate. In Asia, the rate is highest in Nepal, at 4.3 percent per year, and consequences for the people living downstream in India and Bangladesh are severe. Thailand clears 3.6 percent of its remaining forest each year, while Sri Lanka, Laos, Malaysia, and the Philippines all have deforestation rates above one percent per year.

The countries of Sahelian Africa and South Asia do not feature among the nations with high deforestation rates mainly because in their heavily populated regions the closed forests have already been destroyed. But if similar data were available on the process of gradual conversion of open forest to desert, South Asia and semiarid Africa would stand out.

This is the kind of information we now have on deforestation. What of the data we need for policy analysis, but do not yet have? As I have already implied, there is much too little data on how resources are being changed in areas that remain classified as forest. Projections for policy analyses are doubtful when we don't even know whether the deforestation rates are accelerating or decelerating. We need much better information on interactions among causes, such as population growth, urbanization, agricultural productivity, logging practices, land tenure, layouts of road networks, demand for fuel, lack of appropriate forest use technologies, lack of technology transfer agents, misguided development efforts, and so forth.

Very little progress has been made in the last few years in documenting the consequences of deforestation in ways that will compel policy makers in tropical nations to establish and enforce forest resource policies. We know that irreplaceable genetic material is being lost as a consequence of deforestation, and compelling logic indicates that the rate of loss is higher than ever before. But there is too little information to prove that this results in a loss of economic opportunity for the nations where those genetic materials are being lost. Similarly, too little information exists on exactly how deforestation in various tropical environments affects streamflow, silt loads, groundwater aquifers, and other resources having direct consequences on agriculture. For years, authors of World Bank and AID plans for irrigation projects have mentioned, in passing, that the planned reservoirs and canals would soon fill with silt if deforestation were not controlled. But with no hard data for economic analysis, that remained an observation made in passing, and the irrigation projects have proceeded without coordination with forest resource projects. Just recently, some World Bank-sponsored projects have begun to include watershed protection components, with something like two to three percent of the project funds.

So far I have discussed the data we have and the data we still need on deforestation. Let me now turn to the data needed to develop solutions for the deforestation problems.

RESEARCH NEEDED TO SUPPORT SUSTAINED USE OF TROPICAL FORESTS

Information compiled for OTA suggests that social and economic factors are both the major causes of deforestation and the major constraints to forest management and reforestation. Thus, the first need for research is in the social sciences--anthropology, sociology, economics, and education. Unfortunately, most of the specialists working on tropical forest issues are natural scientists and they simply do not have the training to develop an adequate understanding of the socioeconomic side of tropical forest resource systems. More social science field work and technical analysis is necessary to work out feasible ways of improving forest resource use systems. This need is universally recognized by the tropical forest experts we are contacting in our assessment process. Yet the number of social scientists working on tropical forest resource issues is so few that we have yet to find good information on such questions as: what are the necessary and sufficient social and economic conditions needed to cause the spontaneous spread of sustainable land use practices?

This is not to imply that sustainable technologies for use of tropical forest resources have been developed and simply await resolution of the socioeconomic constraints. In fact, we have learned of no management techniques that can produce commercially important quantities of products for use outside the forest and simultaneously sustain the ecological diversity typical of tropical forests. This has led several emminent scientists to conclude that tropical forests are non-renewable resources. However, our assessment indicates that this judgement is premature. There simply has been

very little research in which the goal is to develop management techniques that could sustain the forest in its natural condition while providing substantial products for commerce. There are several proposals for such research and these seem based on good science and sound logic.

Some technologies do exist for management of tropical forest resources. Work to develop such technologies dates back at least to the nineteenth century. However, most of these technologies reflect the goal of colonial governments that sponsored their development, i.e., production of industrial wood for export. Forests under such management lose their ecological diversity but, at least in theory, yield economic returns. The problem is that the management systems that are available are seldom, if ever, implemented. Very few efforts are being made to improve the old management systems or to adapt them to site-specific conditions.

One type of tropical forestry where some progress is being made is in establishment of forest plantations on previously cleared land. Important advances in biotechnologies and plantation forestry in temperate and sub-tropical areas are beginning to be applied in the tropics. These include innoculation of seeds with microorganisms that improve nutrient cycling and mass production of superior strains of trees by tissue culture. Even more important than these techniques stemming from laboratory work is field experimentation being carried out by scientists and development project managers, who are testing different tree species and genetic varieties and new techniques for plantation establishment and management.

Several groups of foresters and biologists concerned about the slow pace of research on maintaining tropical forest resources have produced lists of research priorities. Our assessment has not yet developed a judgement about how to rank research priorities. It appears that all the priorities

identified by the National Academy of Sciences Committee, by the Interagency Task Force, and by the FAO Forestry Department and World Bank are necessary for the development of sustained resource systems in the tropical forest areas. However, it also seems doubtful that the lists of priorities, even if implemented, would be sufficient.

One of our commissioned papers, by Dr. David Dawson, identifies a structural cause for the insufficiency of forest research. This cause pertains even within the United States, where research issues are much simpler and the forest research effort is far larger and far better organized than in the world's tropical regions. Quoting Dawson: "Most managers simply do not judge they have the time to read--to say nothing of conducting library searches for--the information constantly being generated by research. Each year there are [within the U.S.] national, regional, and State workshops and conferences conducted by universities, Departments of Natural Resources, the Forest Service, or the Society of American Foresters to acquaint managers with new findings. Yet only a fraction of managing foresters attend because of fiscal restraints or higher-priority duties taking precedence. Technology transfer from U.S. research laboratories to tropical foresters presents even greater problems, because of the distance, language, and lack of access by the tropical foresters to data bases." Thus, technology transfer, from researchers to project managers, seems likely to be a principal problem.

What is the solution? We have no conclusion yet, but probably it will involve some restructuring of the research effort, not simply more money for more research.

OTA staff were invited by one of our Advisory Panel members, Dr. Norman Johnson, Vice President for the North Carolina Region of Weyerhaeuser Company, to see how private industry resolves this problem of technology transfer. In

North Carolina we interviewed the research staff assigned to Weyerhaeuser's forest management programs there. Subsequent interviews, with Dr. William Ladrach of Carton de Columbia and other scientists, confirmed that industry has found a cost-effective way to get the results of research implemented quickly. Weyerhaeuser's method is to have a research component associated with each action project. This is not regularly done by AID, the U.N., World Bank, or other sponsors of forest projects in the tropics; neither is it done by governments of tropical nations.

SUMMARY

In summary, the conversion of tropical forest to degraded forest and to non-forest is likely to continue and indeed may accelerate with increased populations of landless farmers and improved technologies for razing the forest. Unfortunately, this conversion is not limited to the land that will support agriculture. The consequences for the United States of such conversion include jeopardized sources of supply for imports to the U.S. of agricultural germ plasm, pharmaceuticals, chemical feedstocks, foods, drugs, animals for medical research, tropical hardwoods, veneer, and wood products. U.S.-funded development projects in tropical countries are also in jeopardy, as are U.S. migratory wildlife species. Most importantly, the opportunities for tropical nations to achieve self-sustaining levels of agricultural or industrial production are diminished when forests are converted into wastelands. For example, the poverty and political turmoil in El Salvador and Haiti are attributed by expert analysts partly to the severe degradation of those nations' resources.

To slow and eventually halt forest degradation, and to reverse the trend so that the productivity of the forest resources might be sustained in perpetuity, will require new policies and new programs, and these must be based on new knowledge. Even with increased funding, fundamentally new approaches to research and technology development are necessary.

Mr. SCHEUER. Thank you very much for your very interesting testimony.

Let me ask Mr. Conahan, you have made some measured criticisms of the deforestation programs of AID. Are there any other programs or studies you know that sort of validate your findings, any prior studies, perhaps?

Mr. CONAHAN. Yes, I believe there are. I believe that there are internal AID evaluations that point to similar problems found in the countries that we looked at.

Mr. SCHEUER. Yes. The AID program in deforestation is only 3 or 4 years old, as I understand it. Might it be considered a little bit unfair to evaluate it now, or is this a proper and legitimate period—timewise—where it should be subject to some scrutiny?

Mr. CONAHAN. I think that in view of the testimony given by others today and other studies, all of which generally conclude that increased attention is needed, that this might be a pretty good time to take a look at the way that AID and others are going about developing and designing projects in this area.

If one can come to a definitive conclusion that projects could be designed a little more effectively, I think that we should take a look at it now, and I think that our study showed that on a case-by-case basis, a different kind of project might make a little better sense to correct the deforestation problems in a more immediate way.

Mr. SCHEUER. The fact that you examined only five countries, with AID deforestation projects, I take it you do not feel this small number is injurious to the integrity of the study so as to rob it of its validity? Putting it another way, are those five countries more or less typical of AID's forestry projects or the range of countries they are working in?

Mr. CONAHAN. Yes, sir, I think they are typical; I think they are representative. We also selected these particular countries in order to achieve geographic as well as other representation. We also corroborated it, as I mentioned, with other information that we were able to get. You ask at the outset, "Are there other studies?" "Yes, there are other studies," and we considered them.

We think, therefore, that we have seen enough to suggest that AID consider some of these additional matters as they are designing projects. We are not suggesting that in any particular case, a project might look different from the way it is now, but there are some examples that we saw which would suggest that much greater attention needs to be given to the subsistence farmer as an alternative to the immediate assistance, for example, to institution-building when there simply is no government commitment to that at the moment. There are large, identifiable groups of these landless people out there who are not presently being assisted in devising new and better agricultural techniques.

Mr. SCHEUER. Thank you very much, Mr. Conahan.

Dr. Vietmeyer, your testimony was most remarkable and interesting. You mentioned several plant species and animal species that potentially could be very useful in tropical forests, and you described the animals and you showed us some plants.

What is the United States doing, what is the National Academy of Sciences doing to maximize the research that is going on in rais-

ing these animals, developing new hybrids perhaps, and in developing these new strains of trees? In your opinion, is the present level of research and development adequate? If it is not adequate, what should it include? What you told us and showed us was very exciting. Is there any way we should enlarge the program or accelerate greater progress, or do you think the order of magnitude of the program that exists now is optimal?

Dr. VIETMEYER. Ours is a very small program within the Academy. It is myself and an assistant and a secretary. I think what we are pointing out is the huge resource that is just not being tapped, has not been looked at in the past. There are something like half a million species of plants in the world and yet we cultivate, as food plants, only about 150. That gives you an idea. There are about 80,000 edible ones. In animals there are something like 3,000 mammals and we use 6, I think, with any real intensity.

It is easy for us, with a small program and a lot of correspondence and National Academy of Science panels, to come in and point out some of the promising things. We then send the books out, and it is truly amazing the excitement with which they are received. I gave you some idea of the numbers of requests but there are literally tens of millions of dollars—as a matter of fact, if you count one of our plants, jojoba which is growing out on the desert in Arizona and which we brought to attention in the early 1970's, it is more than $100 million that is now being invested on these——

Mr. SCHEUER. I am sorry to interrupt you, but I take it that is a plant that will grow in dry, arid air.

Dr. VIETMEYER. That is right, and we have another one that is guayule, you may have heard of as the shrub native to Texas that has natural rubber in it. That was another one. You see, if you talk to botanists and some of these foresters who are here, they can give you all kinds of names of species like this that nobody really has paid much attention to. There are just so many of them, and in the past decades there really has not been the great push, there has not been the need for them.

Mr. SCHEUER. However, what you are talking about there, these plants developed in Arizona would be appropriate for sub-Saharan Africa and for the Middle East, the Arab countries, which are just pitifully denuded of——

Dr. VIETMEYER. Absolutely, and there is a fascinating program in south Texas using prosopis species that a young plant scientist brought in from Argentina and Chile that grow with enormous speed, and that is right in a very arid area.

I think that what is happening, now there is an awareness that there are species beyond the ones we really have dealt with. There is kind of a groundswell building now. There are some bottlenecks. For instance, one is seed for these plants. It is very difficult to find seed that can be guaranteed, that is of quality and will not carry pests and so forth. I think that is a particular research need with some of these species that I have mentioned and for which there is a need for greater support.

Mr. SCHEUER. Well, now, you mentioned the enormous number of species, both as to plants and to animals, which are not being exploited, not being used. You say of 3,000 animals we only use 6 domestically, and of the plants——

Dr. VIETMEYER. There are 80,000 edible species and we use 150, maybe,

Mr. SCHEUER. Who is scrutinizing the 99-whatever percent of the plants and animals that are not being utilized, who is screening these unexploited genetic species to see which ones of them would be appropriate to the various environments in the developing world as well as in our own country where we have serious problems of deforestation, in humid areas, in dry areas? Who is looking, who is screening them in a systematic, orderly, disciplined fashion?

Dr. VIETMEYER. There has long been a branch of plant science called economic botany, and that is what those people do. There are not many economic botanists. They have never been given much attention in the past because everyone thought that wheat and corn and soybeans and potatoes—what else do we need, you know? However, there is a wealth of knowledge and we in our NAS program have been trying to gather the best of the economic botanists' wisdom, to select species with promise. Our book on tropical legumes contains literally dozens of legumes. These are all plants that fix their own nitrogen, that do not require nitrogenous fertilizer, and we have another one which I am afraid is not on your pile but I have it in my briefcase, called "Underexploited Tropical Plants," which describes 36 species that look like they could be world-beaters and yet nobody every really heard of them.

It was published already almost 10 years ago, and one of the species is jojoba, and you can already find it on the drugstore shelves here in Washington. Another one is guayule. Another one is winged bean. I don't know if you have heard of that. It is a potential soybean of the tropics. Another one is guar, is starting now to be grown extensively in Texas, so there is a vast wealth of plant material and animal material, and all we have to do is get our blinders off. It is exciting work and it is very, very promising for the future.

Mr. SCHEUER. Well, what you say is all very exciting. If you were sitting up here and you had some responsibility for determining public policy in our Nation's agricultural research program, what would you be advocating?

Dr. VIETMEYER. I would make sure that one small segment of the research budget was set aside for these alternatives. You see, the problem is when you have so many soybean farmers and corn farmers and wheat farmers all screaming for help, somebody who wants to work on jojoba or some plant that nobody ever heard of does not have a chance against that competition. Funds should be earmarked and carefully designated. It does not have to be very much. It can be very small but it has to have a solid wall around it. Otherwise it disappears.

Mr. SCHEUER. Therefore, what you are suggesting is that some of these new plants and new animal species are more appropriate for these areas that are in the process of suffering deforestation, or have already suffered, have been denuded, let us say, that some of these new animal and plant species could be more appropriate for these various kinds of areas that are subject to deforestation than the plants and the animal species that we traditionally use and are using now.

Dr. VIETMEYER. Absolutely. In fact, when we use the world "underexploited" that means underexploited to us. Many of those species are already very well known in certain tribal groups or certain geographical areas but they get no research, particularly international research. Therefore, the people who want to work on soybeans or potatoes or something, they take all the research dollars away. If I could just give you one other example because you were asking about animals——

Mr. SCHEUER. Please do, yes.

Dr. VIETMEYER. Our first animal book is "The Water Buffalo," and I think you have one there. Everyone in the Western world thinks of this as a poor man's animal of Asia that has to have water and is only good for pulling a plow. Well, there is now a herd in Louisiana and some in Florida, and they are doing spectacularly well, and last fall——

Mr. SCHEUER. Well, you say they are doing spectacularly well. In what respect? Are they meat animals? Are they animals that are grown for their meat?

Dr. VIETMEYER. Producing more meat and more calves than the cattle that they are running with on the same pasture. Now this is on poor pasture, not in a feedlot. We are not sure that buffalo can compete in a feedlot where you are stuffing them with corn. However, where you put them out on poor grass, poor pasture, they have a physiology that can convert that into meat more efficiently and more effectively than cattle can.

A year ago a taste test was held at the University of Florida. They had beef steaks and buffalo steaks, not marked, you know.

Mr. SCHEUER. A blind test.

Dr. VIETMEYER. A blind test, and the people complained that one of the types of meat had an off-flavor, and that turned out to be the beefsteak. Therefore, actually water buffalo when it is raised for meat—and I know of four other taste tests that have been held, and every one the buffalo won—so this is an animal with much greater global potential than has ever been recognized.

Mr. SCHEUER. This is the typical water buffalo that you see in Asia?

Dr. VIETMEYER. That is right.

Mr. SCHEUER. Around, mostly around rivers and streams and water.

Dr. VIETMEYER. They are like big dogs. You see a little child walking along and this big animal just plodding behind it. They become part of the family. They really are like pets.

Mr. SCHEUER. Can they survive in a dry climate with very limited water?

Dr. VIETMEYER. They do not need water for wallowing but if they do not have water they do need some shade, they do need a tree.

Mr. SCHEUER. Some shade; yes.

Dr. VIETMEYER. However, the water buffalo is Egypt's main animal resource; you find them in Pakistan, you find them in northern Australia. You do find them in dry areas, although that is not the main potential for them.

Dr. SCHEUER. Thank you very much, Dr. Vietmeyer.

Mr. Ross, on page 2 of your testimony you indicated that although the deforestation data base is not totally sufficient, it has

improved substantially since the late seventies. I think you mentioned 1978.

Mr. ROSS-SHERIFF. Yes, sir.

Mr. SCHEUER. What research or what resource is needed to improve data on how the various tropical environments affect groundwater aquifers, silt load, stream flow, et cetera? Is there any information, for example, that the United States should develop on temperate-tropical forest research in areas that could be useful and could be exchanged with foreign countries?

Mr. ROSS-SHERIFF. Yes, sir, there is a great deal of that kind of research that needs doing. For example, the impacts of forest cover on hydrology, on stream flow, are not nearly as well understood as you might deduce from reports that tell you that deforestation results in more frequent and severe flooding. Those who are trying to call attention to the deforestation problem like to point out the terrible flood in 1979 on the Ganges River system and to say it was a consequence of deforestation. In fact, the data to show the relationship between deforestation or the change in forests and hydrological systems are very poor for tropical situations. The data are much better for temperate systems. Our Forest Service and other scientists in the United States have done extensive research these kinds of relationships in the United States. More of that kind of research could be very profitable in the tropics.

Mr. SCHEUER. Can Landsat be used to improve data quality on environment and what not that we are distributing to Third World countries?

Mr. ROSS-SHERIFF. Certainly it already was very important to the Global Environmental Monitoring System that gave us the better data that I mentioned as being like a snapshot—that is, one point in time. If UNEP continues to be supported and the GEMS program continues, we soon will have a time series of data that will help us begin to understand the real causes, the real dynamics of deforestation. When we have a better understanding of the causes, Congress and other policymakers can certainly make much better policy to deal with deforestation. Such an understanding will rely heavily on data from Landsat and from the monitoring systems.

Mr. SCHEUER. Is there anything—and I would address this to both you and Dr. Vietmeyer—is there anything that you think we can do to improve the quality of the Global Environmental Monitoring System. GEMS; the quality of the data that we are getting out to the developing world? If you care to contribute here; please do. Is there anything we can do to improve both the quality of the data that we make available to the Third World, the timeliness of the data, and also the way in which we systematically distribute the data, presumably in a form that is meaningful to them? Is there some kind of contribution that Congress could make that would improve the GEMS program, improve its utility to the developing world countries?

Mr. ROSS-SHERIFF. I have no criticism to offer the GEMS program, or any advice other than that Congress can work to assure that it continues. UNEP is so not being so strongly supported as we might hope. The U.S. support for UNEP is not among the highest priorities in our support for the U.N. I think probably the main

thing we can do is support UNEP in general and the GEMS program in specific so that the work can continue.

Mr. SCHEUER. Well, I think we are all determined to keep it up. What I am asking is, is there any way we can improve it, improve the quality of the reporting or improve the way that we pass on the information to developing world countries in forms that are useful and intelligible to them?

Mr. ROSS-SHERIFF. Well, not looking specifically at the GEMS program but in looking at Landsat data in general, yes, there can be a much better, much larger effort in technology transfer, particularly now that small computers are available which can handle the Landsat data. The systems for the computer analysis of Landsat data has gotten much less expensive, and I think we could do more to assess how to transfer that technology and how to make it most useful to forestry departments, land-use planners, and others of that type in the many lesser developed countries that, unlike Brazil and some of the bigger countries, cannot afford their own large-scale programs.

AID used to have such a technology transfer program. I think it is not being continued.

Mr. SCHEUER. To transfer what?

Mr. ROSS-SHERIFF. The Landsat interpretation technology to the less-developed nations I think that they have become less active, although I am not an expert on that. Certainly there is a great deal of scope to do a lot more, especially since in the last 2 or 3 years it has been possible to use inexpensive minicomputers to interpret some of this very high-quality data. Before that, it was a matter of large U.S. firms going in and doing contract work and coming back to the United States where they had their big computers to analyze the data. Or else it was a matter of sending something that looked like an air photo out to the LDC's to let their air-photo-trained technicians analyze it. Now we have something much better, which is to transfer the small computer technology.

Mr. SCHEUER. With these small computers, do they directly receive the Landsat information, or must we receive it and pass it on to them?

Mr. ROSS-SHERIFF. We must receive it and pass it on to them. That system, I think, is well organized. The information is inexpensive. There is some competition now. The French are also offering similar information, and I think the Russians have similar information, although they do not make it very widely available.

The system for getting the data to a user is quite well organized. The problem is transferring the ability to use that data, to analyze it and put it to work.

Mr. SCHEUER. Yes, that is important, and it would be much better for our relations with these countries if we could pass them data which they could interpret and apply themselves, without our having always to be in the position of teacher, explaining it to them and interpreting it to them.

Our very distinguished and competent minority counsel, Ms. Bach, has a question for you.

Ms. BACH. Thank you, Mr. Chairman.

On the line of questioning regarding Landsat, on page 2 of your testimony you speak to the fact that some tropical nations still

gather their data by means other than Landsat. Is that because they do not have receivers for the satellite information? Are we talking about gaps, data gaps, and is there a way that the United States through the Landsat program can improve any type of data gap, or is there a different problem there? Is the problem the transfer of the technology?

Mr. ROSS-SHERIFF. I think it is largely a problem of the transfer of technology. It is also a case that in many countries there simply has been no demand for national level forestry data. That is, they may have Landsat or air photo or quite good ground data on specific forests where there are management projects. But for the very large areas where there is no management going on, there has not been any attempt, even though Landsat may have been available, to measure that forest.

Ms. BACH. Can Landsat data be used to facilitate our knowledge and data base for those areas where the productivity is changing? You mentioned that in your testimony, that we have areas where we know it is forested but the type of forest and the productivity of that forest is changing. Can Landsat be of any assistance there?

Mr. ROSS-SHERIFF. Yes, it certainly can, with a much more intensive use than simply: Is the forest being converted to nonforest or not? That involves a much more expensive research program, a lot more information, and usually very site-specific research so that it is a much more expensive matter but it certainly can be done and it is being used in the United States, Landsat is, to monitor some rather subtle changes in forest productivity and quality.

How soon that sort of thing will be done in the tropics on a widespread scale, I do not know. I am doubtful that it would be very soon.

Ms. BACH. OK. Thank you.

Mr. SCHEUER. Bill Long, can you suggest any ways in which we can improve the quality and the usefulness of the data that we are passing along through the GEMS program to developing world countries?

Mr. LONG. Yes, I can make a few observations. First of all, Mr. Chairman, the GEMS program, from the start has been the No. 1 U.S. priority in UNEP. We envisioned at the outset UNEP providing a service of monitoring the health of the environment to tell us where we had emerging problems, all the way from problems with forests, to arid lands, to human settlements, et cetera.

We have been continually disappointed that GEMS activities have not moved along more quickly. Now what we see coming out of the tropical forest area, with the results of the UNEP-FAO survey, is very encouraging. When we take a look at what the GEMS program actually consists of in UNEP, there are essentially five people attempting to administer it with a $2 million budget. We have been talking to UNEP about getting more people working on this program and also people who are more scientifically and technically qualified.

That is part of the answer. As I mentioned earlier, next year there is going to be an assessment by governments of the total GEMS program, and at that time we can press for changes.

There is a second point, one which Mr. Ross mentioned. That involves the data that we provide through our Federal agencies to

the GEMS people which is then sent to other governments. We are working to improve and expand what we, as a government, contribute to GEMS. NASA contributes, EPA contributes, and so do a lot of other agencies. Therefore, I think that part of the answer is in improving the channels of communication between our agencies and the UNEP Secretariat. A big part of it is also making UNEP function more effectively in this area.

Mr. SCHEUER. Yes. What effect do you think there will be from the decrease in U.S. funding for GEMS? Will other countries follow our lead and decrease their funding for UNEP and for GEMS? Can you see a sort of a domino effect here?

Mr. LONG. There could well be a domino effect, most likely involving some of the European countries, principally. But support for the UNEP program in the Nordic countries—Sweden, Denmark, and Norway—is high. And the developing countries continue to attach a great deal of importance to UNEP. I think that some of these countries are likely to step in and make up any difference, or at least a substantial part of it.

Our concern is that when we take a look at who is supporting UNEP, there are a number of countries that participate in the UNEP Governing Council, and which benefit directly from UNEP, which do not pay it anything.

Mr. SCHEUER. Developing countries or developed countries?

Mr. LONG. Both, both. Some of the more advanced of the developing countries we think are paying a disproportionately small share. Our position is that the UNEP Executive Director ought to press other countries to increase their contributions, in some cases starting from a base of zero. There is a lot more that could be done by others, and that is our position at the present. Thank you.

Mr. SCHEUER. Well, thank you very, very much.

I want to thank the entire panel for a very stimulating, interesting, and challenging hour or two here. In 2 minutes we are scheduled to have a vote on the floor on the emergency job bill, so we are going to have to terminate the hearing, and I do that reluctantly because I could sit here for hours asking you additional questions.

However, you have been very patient. You have been very forthcoming. Your testimony has been enormously stimulating, and we thank you very much. We will suspend the hearing.

[Whereupon, at 5 p.m., the subcommittees recessed, to reconvene at the call of the Chair.]

APPENDIX

Questions and Answers Submitted for the Record

IMPLEMENTATION OF NEW DIRECTION IN FORESTRY

QUESTION: The leading multilateral aid agencies (e.g., FAO, World Bank) are beginning to shift the emphasis in their forestry policies away from the industry sector and towards community forestry, agroforestry and institution-building, but implementation of new policy direction is lagging.

What steps is the U.S. Government taking to encourage more rapid implementation of the new policy direction?

ANSWER: There definitely has been a shift in emphasis away from the industry sector and towards community-based forestry, agroforestry, and institution building in forestry projects of the leading multilateral aid agencies. Implementation of the new policy direction is not lagging, but has advanced quite well over the past five years.

The U.S. was instrumental in encouraging this shift in FAO, World Bank, UNEP, and UNDP, and continues to support the shift in emphasis through the formal multilateral aid agency policy-making fora.

Informally, U.S. Government institutions such as A.I.D. and Forest Service are contributing to the consolidation of this shift by cooperation with UN institutions at all levels of project development and implementation.

COORDINATION AMONG DEVELOPMENT ASSISTANCE INSTITUTIONS

QUESTION: Section 118 (Environment and Natural Resources) of the Foreign Assistance Act urges improved coordination and cooperation among bilateral and multilateral aid agencies in their tropical forestry activities. However, a draft study prepared for the OTA tropical forestry assessment notes that development aid agencies continue to experience coordination and cooperation problems. GAO's testimony and the State Department's testimony (p. 23) also recognize this problem.

What specific measures is the U.S. Government taking to resolve this problem?

In particular, what actions are being taken to encourage FAO to expand its Committee on Forestry Development and to redefine its terms of reference so as to serve as the central coordinator for tropical forest research, monitoring, training, education and application at the international level?

ANSWER: The U.S. participates in multidonor coordinator bodies such as the Cooperation in Developing Africa (CDA), the OECD Development Assistance Committee (DAC), and Permanent Committee Interested in the Struggle Against Drought in the Sahel (CILSS). In addition, representatives of donor institutions (including A.I.D.) are increasingly forming informal coordination mechanisms in individual LDCs to avoid duplication of efforts, focus project resources, and exchange experience and methodologies. However, there are limits to coordination with other donors due to differences in fiscal and bureaucratic procedures as well as diverse bilateral relationships and program objectives.

The U.S. representatives at the Second Expert Meeting on Tropical Forests (sponsored by UNEP/FAO/UNESCO in Rome, January 12-15, 1982) supported the recommendation to FAO to expand membership and terms of reference of its Committee on Forest Development in the Tropics; and the U.S. Delegation to the Committee on Forestry (COFO) did likewise at the Sixth Session of that Committee in Rome, May 3-7, 1982.

As of this date, FAO has not carried out these recommendations. This matter is being pursued informally with FAO and formally through regular channels by staff of the Department of State.

U.S. GOVERNMENT/FAO RELATIONS

QUESTION: FAO has estimated that more than $3 billion is needed each year to replace wood cut for worldwide industrial and fuelwood purposes. Yet, FAO's Forestry Department presently ranks third in funding behind the Agriculture and Fisheries Departments. For the 1982-83 budget, the Forestry Department will receive $80.7 million of FAO's total resources of more than $1 billion, or less than 10%.

What is the U.S. Government doing to encourage FAO to direct a larger portion of its budget towards forestry and, in particular, non-industrial forestry activities?

ANSWER: The U.S. Government considers agriculture, fisheries, and forestry as top-priority sectors but, in a no-growth budget situation, is not encouraging FAO to reprogram funds between sectors.

On the other hand, the U.S. is encouraging FAO to program its resources more efficiently and integrate the agriculture and forestry project activities more actively so that its development assistance is more productive.

House Committee on Science & Technology
Dr. Nyle C. Brady's Testimony
September 16, 1982

FORESTRY PROGRAMS IN LAC BY MULTILATERAL AGENCIES

QUESTION: Latin America, which contains more than one-half of the world's remaining tropical forests but which has a deforestation rate more than twice that of either Asia or Africa, currently receives relatively little emphasis in the forestry programs of FAO and the World Bank.

Should the U.S. be encouraging FAO, the World Bank and other multilateral aid agencies to devote a larger portion of their resources to forestry activities in Latin America, and, if so, how?

ANSWER : According to widely accepted FAO figures, the annual rate of deforestation in Latin America is .60 percent compared to .62 percent for Africa and .61 percent for Asia. In other words, the annual rate is roughly equivalent in all three regions. However, since Latin America has 56 percent of the world's tropical forests and the rate of deforestation is increasing more rapidly than in the other two regions, the problem of deforestation is more acute in Latin America.

The FAO and InterAmerican Development Bank have already undertaken forestry activities in Latin America. The World Bank, Canada and the FRG also have significant forestry activities underway in this region. In both relative and real terms, however, dwindling resources are forcing all donors to cut back and refocus assistance to the most financially needy countries. FAO and World Bank therefore are placing more emphasis on Africa, where most of the world's poorest countries

are located. We believe that the United States should be encouraging the FAO, World Bank, and other multilateral aid agencies to devote increased resources to reforestation in Latin America. However, the best means is not by reducing reforestation support in other regions but encouraging them to utilize resources for this purpose which are now earmarked for other non-natural resource management activities in the region.

This can be accomplished directly through United States participation in the development of these organizations' policies, for example, the United States has a seat on FAO's biennial Policy Committee. This can be done through out continuing contacts at a technical and policy level with our counterparts in these organizations.

U.S. STRATEGY CONFERENCE ON BIOLOGICAL DIVERSITY

QUESTION: What are the Department of State and A.I.D. doing by way of follow-up to the November 1981 U.S. Strategy Conference on Biological Diversity?

ANSWER: A number of actions have been undertaken since the November 1981 conference and future activities are being planned. Actions completed include the publication and distribution of the conference proceedings both in the U.S. and overseas. In addition, discussions are underway with the Global Issues Working Group chaired by the Council on Environmental Quality (CEQ) on possible establishment of an Interagency Task Force on the Conservation of Biological Diversity as recommended at the conference. The first responsibility of this task force would be to review the other conference recommendations and identify priority actions which such a task force should undertake as well as actions which participating agencies should consider incorporating in their own programs.

In terms of A.I.D.'s programs, the collection and protection of plant genetic resources is a high priority. The Agency provides 25 per cent of the budget of the International Board for Plant Genetic Resources. We anticipate that our contribution will increase from $850,000 in 1982 to $950,000 in 1983. We also provide 25 per cent of the support for the other 12 International Agriculture Research Centers, a number of which have excellent collections of germplasm which are constantly being enlarged. Crops which are covered include: wheat and maize at the International Maize and Wheat Improvement Center in Mexico (CIMMYT); rice at the International Rice Research Institute (IRRI) in the Philippines; beans and cassava at the International Center for Tropical Agriculture (CIAT) in Colombia; sorghum, millet, chick peas, pigeon peas and ground nuts at the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) in India; barley, durham wheat, faba beans and lentils at the International Center for Agriculture Research in Dry Areas (ICARDA) in Syria; potatoes at the International Potato Center (CIP) in Peru; food legumes, roots, tubers and rice for Africa at the International Institute of Tropical Agriculture (IITA) in Nigeria; and collection of native high land legumes of East Africa is beginning at the International Livestock Center for Africa (ILCA) in Ethiopia.

In addition, A.I.D. is expanding its programs in this area by funding activities such as the identification of little known tropical plants with potential economic value in Peru and a program which supports the establishment of protected areas for watershed and wildlife protection in Sri Lanka.

INTEGRATION OF FORESTRY PRACTICES INTO SOCIOCULTURAL SYSTEMS

QUESTION: The 1980 U.S. Interagency Task Force on Tropical Forests Report stressed the need to integrate forestry practices into socio-cultural systems.

What specific actions has the U.S. Government taken in response to this problem?

ANSWER: A.I.D.'s ongoing and planned forestry projects clearly respond to the need to integrate sound forestry practices into the socio-cultural systems which must accept and implement them. Most bilateral assistance projects in forestry are intimately related to meeting needs for fuelwood, water and food. The forestry practices being tested, demonstrated, and replicated in LDCs through A.I.D.'s program are related to on-farm and community-based production systems. Training in forestry extension techniques is an important component of many projects.

Project identification and planning often include social scientists (sociologists, anthropologists, etc.) to help prepare social analyses and cultural impact statements. For example, the recently approved A.I.D. Forestry Sector Development Project in Ecuador was planned by a team of experts which included an anthropologist whose expertise covers a knowledge of indigenous populations of Ecuador and their social/cultural systems. The project is predicated upon the adaptation of forestry practices to the diverse sociocultural environment of Ecuador. Likewise, the Haiti Agroforestry Project implementation team is headed by an anthropologist.

Two "Social Forestry" projects to which A.I.D. is contributing in India (approximately $25 million each) include training of foresters and other local extension agents to deal as much with social organizations and individual farmers as with the biological aspects of forestry.

The expanding Peace Corps forestry program stresses the integration of forestry into sociocultural systems, and the U.S. Man and the Biosphere Program has given weight to this integration in its research grants program.

In general, the U.S. emphasizes this focus in dealing with multi-lateral aid agencies and other bilateral donors.

COORDINATION BETWEEN A.I.D. AGRICULTURE AND FORESTRY OFFICERS

QUESTION: To what extent do A.I.D.'s agriculture officers, both in Washington and in A.I.D. field Missions, coordinate with A.I.D.'s forestry and natural resource officers in the design, planning and implementation of proects that may affect tropical forest resources?

ANSWER: The majority of A.I.D.'s forestry investments (77%) are components within larger agriculture, rural development and energy initiatives. The design, planning and implementation of these projects are carried out by interdisciplinary teams of A.I.D., contract, and host-country personnel which include foresters, agronomists, social scientists, planners, etc. Under this arrangement, A.I.D.'s field agriculture officers play a significant integrative role in this process.

A.I.D. now has ten (10) forestry and environmental advisors placed in the field, with regional or subregional responsibilities, who participate in and influence the design, planning and implementation phases of all projects that may affect tropical forest resources. They coordinate with agriculture and other A.I.D. specialists in carrying out their duties.

The involvement of foresters, agriculturists, and other natural resource specialists in the design phases of the Pichis-Palcazu Tropical Forest Development Project in Peru and the Mahaweli Regional Development Project in Sri Lanka are examples of A.I.D.'s concern for the impact of development projects on tropical forest resources in the LDCs.

General recognition that the conversion of forested land to support agricultural production is a major cause of deforestation has also resulted in an increase in coordination between forestry officers and agriculture officers in Washington.

The technical staffs of the Science and Technology Bureau's Office of Agriculture and Office of Forestry, Environment and Natural Resources and their counterparts in the Regional Bureaus are becoming more involved in dealing with activities common to each other's concerns. A good example is the planning and approval of an Agroforestry Farming Systems Research and Training Project that is part of the portfolio of the Office of Forestry, Environment and Natural Resources in which agriculture and forestry officers participated. In general, technical oversight of many projects involves coordination between agriculture and forestry specialists as well as other professionals.

House Committee on Science and Technology

P. L. 480 Used for Tree Planting

Question: More than one-half of all tree planting worldwide under U.S. foreign aid is being carried out through P.L. 480 funds; yet, at the present time, more than 90% of the some $1.6 billion in P.L. 480 funds is directed towards non-forest related projects.

Is A.I.D. seeking to increase the portion of P. L. 480 funds directed towards tree planting?

Answer : Natural resource renewal in the developing countries is a major concern of A.I.D. Under P.L. 480 forestation projects, providing windbreaks and/or fuelwood, are undertaken both through the self-help measures associated with Titles I and III or through Food for Work activities under Title II. A.I.D. is encouraging programmers of P. L. 480 to give increased attention to tree planting as well as other types of natural resource renewal.

Question: What proportion of actual and planned tree planting is or will be carried out on degraded or marginal lands?

Answer : Most of the P. L. 480 reforestation activities are carried out on lands which are marginal for intensive agricultural production. Much of this land is highly eroded or erodable.

PLANTATION/DEFORESTATION RATIOS

QUESTION: The UNEP/FAO Global Assessment of Tropical Forest Resources, published in April 1982, estimates that for every hectare planted in plantations each year, some 4-5 hectares of tropical forest will be converted or destroyed in Asia, some 10.5 hectares will be converted or destroyed in the Americas, and some 29 will be converted or destroyed in Africa.

Does the U.S. Government share in this assessment?

ANSWER: While A.I.D. and the Department of State agree with the global/regional assessment, it is felt that other dimensions of deforestation which are equally important must also be taken into account. The irreversible loss of species and unique forest systems requires that these species and systems be better identified and action programs, including preservation of some areas, increased. The replacement of closed natural tropical forests with plantations may result in an increase in some forest products but will not replace the species diversity and some important environmental influences of natural forest cover which are very important to local populations.

Better data are needed to identify endangered tropical forest systems and species, in addition to baseline data on the overall area affected by deforestation.

There has been a significant increase recently in reforestation throughout the LDCs. This is commendable and must be recognized, even though much higher rates of reforestation are needed. Besides reforestation through plantations, it is necessary to encourage much more revegetation through natural regeneration, especially for watershed protection and fuelwood production.

House Committee on Science & Technology
Mr. Nyle C. Brady's Testimony
September 16, 1982

A.I.D. FORESTRY ACTIVITIES IN HAITI

QUESTION: In response to a December 22, 1981 letter from Chairman Bonker about A.I.D.'s forestry activities in Haiti A.I.D. noted that its program has suffered many delays in implementation. However, under its Agroforestry Outreach Project, A.I.D. expects to plant some 1 million trees before the end of FY 1982, and that "present overall outplanting projections are 6-9 million trees over the 4-year life of the project." Dr. Brady refers to this project on pp. 14-15 of his statement.

What is the status of the 1 million trees that were to be planted by the end of FY 1982?

ANSWER: As of June 1982 over 1½ million tree seedlings had been planted in comparison to the FY 82 target of 1 million.

QUESTION: Is AID's initial projection for an outplanting of 6-9 million trees still valid?

ANSWER: Based on the past year's experience with development and planting of tree seedlings, AID believes the outplanting target of 6-9 million is still valid.

MAN AND THE BIOSPHERE (MAB) PROJECT 1/TROPICAL FORESTS

QUESTION: The UNESCO Man and the Biosphere (MAB) Project 1 on Tropical Forests has been cited as an outstanding example of the site-specific, baseline tropical forest ecology research that international institutions should promote

What is the current status of U.S. funding for this MAB project?

ANSWER: At the present time, the U.S. MAB Consortium spends about two-thirds of its grant funds on Project 1/Tropical Forests research (approx. $200,000 over 3-year period). This amount is provided almost exclusively by the U.S. Forest Service. In addition, the U.S. Forest Service provides approximately $150,000 (starting in FY 1979) for scientific meetings, symposia, etc. in support of joint MAB/USFS tropical forestry activities (mostly at the Institute for Tropical Forestry, ITF, in Puerto Rico).

MIXED CROP/LIVESTOCK FARMING SYSTEMS PROJECT

Item No. 12.

Question: Dr. Brady on page 15 of his prepared statement refers to a Mixed Crop/Livestock Farming Systems project.

What is the status of funding for this project?

Answer: This is a new research project still in the planning phase which has not yet been funded. If funds become available this work may be initiated in the latter part of FY 1983, but is more likely to be FY 1984.

FORESTRY RESEARCH INSTITUTIONS IN TROPICAL COUNTRIES

QUESTION: The need to develop tropical country forest research institutions was identified at a recent OTA meeting as a high priority problem.

In terms of funding and personnel, what type of effort is A.I.D. devoting, or planning to devote to this problem?

ANSWER: Total support provided by A.I.D. for forestry research and research institution building in all on-going forestry projects as of January 1, 1982, was approximately $8 million. All forestry projects being planned at that date taken in the aggregate would provide an estimated additional $10 million in support for forestry research. This total of $18 million includes approximately $2 million in forestry research support being provided by three centrally funded projects: Science Advisor research grant program; NAS grants program on fast-growing, nitrogen-fixing trees; and the Cooperative Agreement with the International Council for Research on Agroforestry (ICRAF). Most of this support contributes to forestry research capacity building in LDC institutions.

Promotion and support for the establishment of forestry research networks in the Africa, Asia, and Latin America/Caribbean Regions are being actively pursued by A.I.D. as a logical complement to efforts to build national research institutes. Other donors are being encouraged to join with A.I.D. in support of specific networks of LDC research institutes working on fuelwood and reforestation of degraded lands.

Projects are being designed to provide technical assistance and training to forestry research institutes in India, the Philippines, and Honduras.

LDC CAPABILITIES TO CARRY OUT FORESTRY DEVELOPMENT PROJECTS

QUESTION: The September 16, 1982 GAO report on Deforestation recommends that A.I.D., "avoid designing projects which propose to do more in forestry and natural resource conservation than developing countries are capable of doing, etc."

A. What is your response to this suggestion? Do you think it is accurate?

B. Does A.I.D. plan any changes in the forestry programs as a result of this suggestion?

ANSWER: A.I.D.'s response to this suggestion (printed as Appendix I of the GAO Report "Changes Needed in U.S. Assistance to Deter Deforestation in Developing Countries" GAO/ID 82-50) pointed out that limiting assistance in forestry solely to institutions that had demonstrated they were already capable of implementing and sustaining such activities would undercut A.I.D.'s institution-building policy objectives and responsibilities. The GAO recommendations in this regard skirt consideration of this critical aspect of A.I.D.'s capacity building function.

As stated on page 50 of Appendix I of the GAO report, "The Agency designs many of its forestry and natural resources projects intentionally to try to expand, stimulate, and promote greater effects, strengthened capacity, and higher priorities for forestry-related programs and management."

Future projects in forestry and natural resources will be designed based upon a realistic prediction of the ability of the LDC institutions involved to grow throughout the life of the project and to assume the financial, policy, and personnel responsibilities upon which each project is conditioned.

INTEGRATION OF FORESTRY ASSISTANCE WITH OTHER DEVELOPMENT PROGRAMS

QUESTION: The September 16, 1982 GAO Report also recommended that A.I.D. "better implement established strategies to integrate forestry assistance with other development programs."

A. What is your response to this suggestion? Is this recommendation accurate?

B. Does A.I.D. plan any changes in the forestry programs as a result of this suggestion?

ANSWER: The majority of A.I.D.'s forestry investments are components within larger A.I.D. agriculture, rural development and energy activities. The Agency has pointed out to GAO that approximately 77% of the forestry effort is thoroughly "integrated" in such activities (pages 48-49, para. 3 of Appendix I, GAO Report: "Changes Needed in U.S. Assistance to Deter Deforestation in Developing Countries," GAO/ID 82-50). The recommendation of GAO, however, still leaves the incorrect impression that the major portion of A.I.D.'s forestry funds are not committed within agricultural and rural development programs.

The Agency will continue to incorporate forestry components in its agriculture, energy and rural development portfolio when it makes programmatic sense. The GAO recommendation did not recognize that A.I.D.'s forestry program was already so well integrated.

Question: Is AID planning any new forestry projects for Africa in FY 1983 and in subsequent fiscal years.

Answer: Yes. In FY '83 we are launching a major $6 million reforestation project in Somalia, utilizing refugee funding and putting emphasis on reforestation within and around the refugee camps with refugee participation and the support of U.S. voluntary agencies based in Somalia. Also, in FY '83 we are planning a reforestation project in the Kassala Province of the Sudan. The project of $5-7 million will be implemented by CARE and the Sudanese Forestry Department under an Operational Program Grant between AID and CARE. We further expect to approve in the near future a small community reforestation project in Rwanda in the amount of $500,000, through funding made available under the Bureau's "Energy Initiatives for Africa" project which was approved in late FY '82. This project will provide a funding source for initiating reforestation/fuelwood activities in sub-Saharan Africa over the next four to five years. In addition, we expect that, as the lead donor for forestry/fuelwood activities among the seven donors that have associated themselves within the CDA (Cooperation for Development in Africa) concept, the Bureau will be helping to support additional forestry/fuelwood activities in such countries as Senegal, Upper Volta and Malawi.

The following questions were submitted by telephone by Phyllis Balin, OTA, Food and Renewable Resource Program of the Subcommittee for Natural Resources, Agriculture Research and Environment.

1. What percentage of UNEP funds does the U.S. provide?

2. What are the other countries that contribute funds? What is their individual percentage compared to that of the U.S.?

3. What effects will the reduced contributions have on GEMS/UNEP?

4. Have other countries decreased funding to GEMS/UNEP?

5. What effect will reduced funds have on environmental quality in the world?

6. What is the relationship between U.S. contribution to UNEP/GEMS and federal research projects in the area of CO_2, forest resource management, and soil conservation?

7. How will changes in GEMS effect U.S. federal science and technology research?

UNITED NATIONS NATIONS UNIES

INTEROFFICE MEMORANDUM MEMORANDUM INTERIEUR

TO: Phyllis Balin
A: OTA, Food and Renewable Resources Program

DATE: 21 October 1982

REFERENCE: _____

THROUGH: S/C DE:

FROM: Joan M. Nicholson
DE: Senior Liaison Officer, UNEP-Washington

SUBJECT: Regarding your inquiry for information for the Joint Hearing
OBJET: Subcommittee on Natural Resources, Agriculture Research and the Environment

Item #1 - The United States currently provides approximatly 20% of UNEP's budget.

Item #2 - Exhibit A lists other countries that donate funds to the United Nations Environment Programme. We have placed asterisks beside top doners. In addition, please note in chapter 6,(UNEP/GC.10/14), which has been xeroxed for you, those paragraphs starred on page 63. I highly recommend a complete reading of chapter 6.

Item #3 - GEMS is funded from the Environment Fund. If contributions are reduced to the overall fund, then the programs the fund sustains will obviously be effected.

Item #4 - If other countries decrease contributions to the Environment Fund, GEMS would be effected. At present, I am not aware of any reduction in funds except by the United States. The International Organization and Program Account of the Foreign Affairs Act is currently operating on a Continuing Resolution. Whereas, our appropriation was $7.85m for 1982, the President recommended a budget of $3m which is the figure dominating the Continuing Resolution, as it is the lowest figure between last years budget and the Administration's recommended budget. Obviously, such a reduction in the U.S. contribution would very directly and adversly effect the GEMS program as a component of the Environment Fund.

Item #5 - The Environment in 1982, Retrospect and Prospect, (UNEP/GC(SSC)/2), which is enclosed, provides an excellent summary of world environmental conditions and the prospects for the next decade starting on page 70. This can prove a useful source for you. Now is not an appropriate time for a reduction in resources pledged to solve world wide environment problems. We have also xeroxed for you a page from the Report Of The Governing Council On The Work Of Its Tenth Session,(UNEP/GC.10/14), which reflected the conclusions of the delegates from governments and their evaluation of GEMS. I would recommend that you investigate

the activities of the Department of Interior, the Environmental Protection Agency, the Department of Agriculture and NASA regarding research projects in the areas you have designated; specifically, CO_2, forest research management, and soil conservation. In addition, the Agency for International Development, through their bilateral activities, are engaged in these subject areas. I have enclosed a document outlining the work of GEMS which clearly delineates its activities and the benefits emanating from the GEMS program. You will note on page 11 of the GEMS booklet that its budget is just over $2m. In information gathering alone, related to climate, the U.S. is realizing a payoff from GEMS activities.

Item #6 - You will also note on page 18, comprehensive information about the GEMS program and its activities concerning CO_2, followed on page 20 by information on its forest research management and soil conservation activities.

Item #7 - A decrease in GEMS activities would obviously slow the capacity of individual nations and regions to anticipate environmental problems. Conversely, a reduction in national science and technology research, especially in countries where there is a high degree of experience and sophistication, can reduce the overall inventory of information investment available to GEMS and thereby reduce its effectiveness.

Hopefully, this information will prove helpful in responding to the inquiries of the Joint Hearing Subcommittee on Natural Resources, Agriculture Research, and the Environment.

Table 1

Exhibit A

Estimate of Resources (1978 – 1981)
(in US dollars equivalent)

Status as at 30 April 1980

* Pledges announced in currencies other than US dollars
** Pledges made partially in Non Convertible Currencies (NCC) NCC contributions

Country	Pledge 1973-1977	Pledge 1978-1981	Years	Estimated 1978-1981	1978	1979	1980	1981
Afghanistan	0	0	0	0	0	0	0	0
Albania	0	0	0	0	0	0	0	0
Algeria	10,000	29,995	3	39,995	9,995	10,000	10,000	10,000
Angola	0	0	0	0	0	0	0	0
Argentina	160,000	260,000	4	260,000	60,000	60,000	70,000	70,000
Australia	2,500,000	2,000,000	4	2,000,000	500,000	500,000	500,000	500,000
Austria	800,000	800,000	3	1,100,000	200,000	300,000	300,000	300,000
Bahamas	0	500	1	2,000	500	500	500	500
Bahrain	0	0	0	0	0	0	0	0
Bangladesh**	2,000	17,000	4	17,000	2,000	5,000	5,000	5,000
Barbados	0	1,000	1	3,000	0	1,000	1,000	1,000
Belgium	1,250,000	600,000	2	1,200,000	300,000	300,000	300,000	300,000
Benin*	945	4,000	2	8,000	2,000	2,000	2,000	2,000
Bhutan	0	1,000	1	3,000	0	1,000	1,000	1,000
Bolivia	0	0	0	0	0	0	0	0
Botswana	6,438	2,802	2	4,068	0	1,266	1,266	1,536
Brazil**	80,000	60,000	3	80,000	20,000	20,000	20,000	20,000
Bulgaria***	2,058	18,479	4	18,479	1,029	5,714	5,868	5,868
Burma	0	0	0	0	0	0	0	0
Burundi	2,195	3,291	3	4,388	1,097	1,097	1,097	1,097
Byelorussian SSR***	53,302	58,150	3	77,906	8,845	19,549	19,756	19,756
Canada	5,000,000	3,400,000	4	3,400,000	1,000,000	1,000,000	700,000	700,000
Cape Verde	0	2,000	1	8,000	2,000	2,000	2,000	2,000
Central African Republic	0	0	0	0	0	0	0	0
Chad	0	0	0	0	0	0	0	0
Chile	7,000	9,000	3	12,000	3,000	3,000	3,000	3,000
China***	425,369	333,333	1	333,333	0	333,333	0	0
Colombia	9,057	19,787	3	9,534	5,000	5,000	9,787	9,787
Comores	0	0	0	0	0	0	0	0
Congo	0	0	0	0	0	0	0	0
Costa Rica	0	0	0	0	0	0	0	0
Cuba***	49,080	0	0	0	0	0	0	0

Table 1

Country	Pledge 1973-1977	Pledge 1978-1981	Years	Estimated 1978-1981	1978	1979	1980	1981
Cyprus	2,000	8,000	4	8,000	2,000	2,000	2,000	2,000
Czechoslovakia***	107,290	113,862	3	113,862	28,195	28,736	28,736	28,195
Democratic Kampuchea	0	0	0	0	0	0	0	0
Democratic People's Republic of Korea	0	0	0	0	0	0	0	0
Democratic Yemen	0	2,323	2	4,323	1,000	1,000	1,323	1,000
Denmark	1,385,000	1,600,000	4	1,600,000	400,000	400,000	400,000	400,000
Djibouti	0	0	0	0	0	0	0	0
Dominica	0	0	0	0	0	0	0	0
Dominican Republic	0	4,000	4	4,000	1,000	1,000	1,000	1,000
Ecuador	0	0	0	0	0	0	0	0
Egypt	20,000	19,649	2	39,649	9,795	9,854	10,000	10,000
El Salvador	0	0	0	0	0	0	0	0
Equatorial Guinea	0	0	0	0	0	0	0	0
Ethiopia	0	0	0	0	0	0	0	0
Fiji	0	0	0	0	0	0	0	0
Finland	900,000	813,265	3	1,113,265	200,000	313,265	300,000	300,000
France*	6,537,407	5,878,948	4	5,878,948	1,290,323	1,764,706	1,428,571	1,395,348
Gabon	0	1,034	1	4,136	1,034	1,034	1,034	1,034
Gambia	0	0	0	0	0	0	0	0
German Democratic Republic***	324,526	718,397	4	718,397	91,721	198,424	214,126	214,126
Germany, Federal Republic of*	8,130,597	9,505,392	3	9,505,392	2,265,367	2,500,600	2,395,675	2,343,750
Ghana	70,146	38,000	2	76,000	19,000	19,000	19,000	19,000
Greece	19,993	6,992	1	27,992	6,992	7,000	7,000	7,000
Grenada	0	0	0	0	0	0	0	0
Guatemala	0	0	0	0	0	0	0	0
Guinea	0	0	0	0	0	0	0	0
Guinea-Bissau	0	8,000	4	8,000	2,000	2,000	2,000	2,000
Guyana	0	0	0	0	0	0	0	0
Haiti	0	0	0	0	0	0	0	0
Holy See	0	0	0	0	0	0	0	0
Honduras	0	0	0	0	0	0	0	0
Hungary***	91,535	100,049	4	100,049	25,668	28,137	24,618	21,626
Iceland	19,000	11,500	2	23,500	5,500	6,000	6,000	6,000
India**	492,433	301,273	3	401,273	100,000	100,062	101,211	100,000
Indonesia	42,000	36,000	3	48,000	12,000	12,000	12,000	12,000
Iran	260,000	400,000	4	400,000	100,000	100,000	100,000	100,000
Iraq	118,636	301,570	4	301,570	75,913	74,703	75,583	76,271
Ireland*	35,001	76,780	3	103,703	24,012	25,845	26,923	26,923
Israel	10,000	25,000	2	55,000	10,000	15,000	15,000	15,000
Italy	1,600,000	400,000	3	1,600,000	400,000	400,000	400,000	400,000
Ivory Coast	1,976	0	0	0	0	0	0	0
Jamaica	10,000	8,000	2	18,000	4,000	4,000	4,000	4,000
Japan*	10,000,000	9,916,660	3	13,519,660	3,000,000	3,319,660	3,600,000	3,600,000

Table 1

Country	Pledge 1973-1977	Pledge 1978-1981	Years	Estimated 1978-1981	1978	1979	1980	1981
Jordan	2,000	0	0	0	0	0	0	0
Kenya	150,597	135,609	3	180,609	44,585	45,998	45,048	45,000
Kuwait	133,300	350,000	3	550,000	50,000	100,000	200,000	200,000
Lao, People's Dem. Republic	0	4,000	1	12,000	0	4,000	4,000	4,000
Lebanon	0	0	0	0	0	0	0	0
Lesotho	3,000	1,000	1	4,000	1,000	1,000	1,000	1,000
Liberia	4,500	1,500	1	4,500	0	1,500	1,500	1,500
Libyan Arab Jamahiriya	300,000	100,000	1	100,000	100,000	0	0	0
Liechtenstein	0	0	0	0	0	0	0	0
Luxembourg*	41,036	33,258	3	43,258	13,258	10,000	10,000	10,000
Madagascar	0	0	0	0	0	0	0	0
Malawi	2,163	9,586	4	9,622	2,305	2,439	2,439	2,403
Malaysia	0	40,000	4	40,000	10,000	10,000	10,000	10,000
Maldives	0	0	0	0	0	0	0	0
Mali	0	0	0	0	0	0	0	0
Malta*	6,993	5,792	3	7,812	1,792	1,980	2,020	2,020
Mauritania	0	4,039	1	8,078	0	0	4,039	4,039
Mauritius*	0	3,003	3	4,003	1,005	1,000	998	1,000
Mexico	900,000	350,000	3	500,000	100,000	100,000	150,000	150,000
Monaco	0	0	0	0	0	0	0	0
Mongolia	0	0	0	0	0	0	0	0
Morocco	50,000	0	0	0	0	0	0	0
Mozambique	0	0	0	0	0	0	0	0
Nauru	0	0	0	0	0	0	0	0
Nepal	0	0	0	0	0	0	0	0
Netherlands*	1,500,000	1,203,884	3	1,660,855	330,000	416,913	456,971	456,971
New Zealand*	328,338	250,534	3	330,821	83,137	87,110	80,287	80,287
Nicaragua	0	0	0	0	0	0	0	0
Niger	0	0	0	0	0	0	0	0
Nigeria	124,000	32,000	1	128,000	32,000	32,000	32,000	32,000
Norway*	2,207,786	3,382,086	4	3,382,086	556,328	804,085	1,021,673	1,000,000
Oman	2,895	6,666	2	9,999	0	3,333	3,333	3,333
Pakistan	10,000	15,000	3	20,000	5,000	5,000	5,000	5,000
Panama*	0	12,000	2	12,000	0	4,000	4,000	4,000
Papua New Guinea	0	0	0	0	0	0	0	0
Paraguay	0	0	0	0	0	0	0	0
Peru	7,000	2,000	1	8,000	2,000	2,000	2,000	2,000
Philippines	50,000	60,000	4	60,000	12,000	14,000	16,000	18,000
Poland***	200,804	185,741	4	185,741	50,201	45,180	45,180	45,180
Portugal	9,000	12,000	4	12,000	3,000	3,000	3,000	3,000
Qatar	10,000	0	0	0	0	0	0	0
Republic of Korea	0	20,000	2	40,000	10,000	10,000	10,000	10,000
Romania***	20,835	20,000	4	20,000	5,000	5,000	5,000	5,000
Rwanda	2,133	2,132	1	2,132	2,132	0	0	0
Saint Lucia	0	0	0	0	0	0	0	0

Table 1

Country	Pledge 1973-1977	Pledge 1978-1981	Years	Estimated 1978-1981	1978	1979	1980	1981
moa	0	0	0	0	0	0	0	0
n Marino	0	0	0	0	0	0	0	0
o Tome & Principe	0	0	0	0	0	0	0	0
udi Arabia	15,000	1,000,000	4	1,000,000	250,000	250,000	250,000	250,000
negal	2,120	10,000	2	20,000	5,000	5,000	5,000	5,000
ychelles	0	0	0	0	0	0	0	0
erra Leone	0	0	0	0	0	0	0	0
ngapore	5,000	4,000	4	4,000	1,000	1,000	1,000	1,000
lomon Islands	0	0	0	0	0	0	0	0
malia	0	1,605	1	4,815	0	1,605	1,605	1,605
uth Africa	0	0	0	0	0	0	0	0
ain	1,000,000	800,000	4	800,000	200,000	200,000	200,000	200,000
Lanka*	1,500	1,000	2	2,000	500	500	500	500
dan	5,366	3,000	2	6,000	1,500	1,500	1,500	1,500
riname	0	0	0	0	0	0	0	0
waziland	2,727	0	0	0	0	0	0	0
weden	5,000,000	7,500,000	4	7,500,000	1,875,000	1,875,000	1,875,000	1,875,000
witzerland*	1,188,922	1,719,925	3	2,357,132	489,476	592,242	637,707	637,707
rian Arab Rep.	0	3,006	3	4,006	1,000	1,000	1,006	1,000
iland	10,000	40,000	4	40,000	10,000	10,000	10,000	10,000
go*	0	922	1	3,688	922	922	922	922
nga	0	0	0	0	0	0	0	0
rinidad & Tobago	0	0	0	0	0	0	0	0
nisia	0	0	0	0	0	0	0	0
rkey	30,000	24,000	4	24,000	6,000	6,000	6,000	6,000
ganda	1,263	1,263	1	5,052	1,263	1,263	1,263	1,263
krainian SSR***	127,872	142,130	3	191,762	46,378	48,120	48,632	48,632
SSR***	10,474,888	15,712,548	4	15,712,548	3,800,087	3,942,857	3,984,802	3,984,802
nited Arab Emirates	0	0	0	0	0	0	0	0
nited Kingdom*	3,927,880	3,914,370	3	5,326,134	1,154,047	1,331,757	1,428,571	1,411,764
nited Republic of Cameroon	0	12,000	4	12,000	3,000	3,000	3,000	3,000
nited Republic of Tanzania	9,625	21,220	4	21,220	5,305	5,305	5,305	5,305
nited States of America*	40,000,000	20,000,000	3	40,000,000	10,000,000	10,000,000	10,000,000 1982-1985	10,000,000
per Volta	0	1,000	1	4,000	1,000	1,000	1,000	1,000
ruguay	0	0	0	0	0	0	0	0
nezuela	50,000	160,000	3	280,000	30,000	30,000	100,000	100,000
etnam (Socialist Republic of)	0	0	0	0	0	0	0	0
men Arab Republic	0	0	0	0	0	0	0	0
goslavia***	100,000	35,000	1	140,000	35,000	35,000	35,000	35,000
ire	125,000	25,000	1	100,000	25,000	25,000	25,000	25,000
mbia	0	0	0	0	0	0	0	0
TOTAL	108,676,332	96,189,423		125,145,262	29,556,282	31,982,095	31,866,354	31,740,531

the basis of official communication from the United States Government there will be no further contribution paid until after the General Assembly. Therefore, there t be great uncertainty as to this figure.

the assessment of environmental impact (beneficial as well as deleterious). Another delegation endorsed that view and reiterated the importance of UNEP focussing on the gaps in existing programmes, while another suggested that the two distinct roles of global co-ordination and support for practical activities did in fact converge, in that many projects dealt with issues having global implications.

148. The representative of ESCAP summarized the Commission's activities in the fields of marine pollution, living marine resources and assessment of desertification in arid lands.

2. Environmental assessment

149. One delegation said that the task of conducting assessments in some 28 areas of environmental concern was an enormous one. As the financial and human resources currently available to UNEP for that task were limited, the areas should be ranked according to their urgency, their relation to human welfare, and their effect on the rate of environmental deterioration. In short, UNEP should not attempt to do too much at the same time. Another delegation, endorsing that view, suggested two priorities: pollution of the seas and environmental health, in particular tropical diseases.

150. Most delegations noted the contents of the list of dangerous chemical substances and processes (UNEP/GC.10/5/Add.3) and appreciated its completion. One announced that it would be proposing a scope of action larger than that formulated by the secretariat. However, many delegations felt that Governments needed more time to study the list carefully: some proposed changes in the text on specific subjects in order to present a more up-to-date picture of the problems discussed. Several delegations said that the scientific content of the document should be checked. It was therefore agreed that the list should be submitted, with its bibliographical references, to Governments for further study and comment.

(a) Global Environmental Monitoring System (GEMS)

151. Many delegations stated that GEMS should be broadly supported and developed, in co-ordination with other agencies and activities. GEMS was a good example of the sort of work UNEP should do - effective co-ordination not necessarily requiring new activities. One delegation emphasized the urgent need to develop further the scientific aspects of GEMS, in order, for example, to achieve more in the monitoring of pollution of the world's oceans, and noted that an International Symposium on Integrated Monitoring in 1981 had stressed the importance of global air pollution monitoring networks. Another delegation stressed that GEMS should concentrate on integrated monitoring on the one hand, and on the integration of flora and fauna and resource data bases on the other, in order to provide effective environmental assessments.

152. Two delegations urged the continuation of tropical forest assessment monitoring with GEMS. One of them observed that the pilot project on the Monitoring of Tropical Forest Cover had suffered from a dearth of training assistance from UNEP, and that its successful outcome was largely due to the efforts of its Government and the Regional Remote Sensing Centre at

Ouagadougou. Another delegation said that, while the proposed project on monitoring desertification processes in South-West Asia had not been effectively launched, those processes were in any case obvious, and did not require monitoring in the subregion - what was needed was strengthening of national capabilities for combating desertification, and its Government had a well-established institute which could provide technical support to other countries in that respect. Another pointed out that the ecological monitoring of rangelands combined the catalytic and operational aspects of UNEP's work, in that it involved UNEP providing financial support and consultancy and promoting technical co-operation among developing countries, to help countries design projects by merging interdisciplinary and inter-ministerial interests, all within the context of regional and global programme objectives.

(b) International Referral System (INFOTERRA)

153. A large number of delegations referred to the operational success of INFOTERRA in promoting a cost effective increase in the flow of information on a wide range of environmental topics. Two delegations suggested that new forms of information exchange should be developed within INFOTERRA to enable it to provide more specific information, besides abstract lists. Another, while praising the subregional workshops, called for increased support for the computer technology necessary to enhance information flow, and stressed the importance for developing countries of INFOTERRA moving beyond referral to the provision of information. A fourth welcomed the increase in numbers of information sources, emphasized the value of the national focal points, and drew attention to the need for effective co-operation between institutions, while a fifth called for greater support to countries requiring both assistance and information.

(c) International Register of Potentially Toxic Chemicals (IRPTC)

154. Many delegations emphasized the importance of the work of IRPTC and stressed their continued support for the Register. Close co-operation of IRPTC with the International Programme on Chemical Safety (IPCS) would be of mutual benefit. Some delegations mentioned the need for assistance from IRPTC to develop simple formats for use by developing countries in establishing national registers of potentially toxic chemicals. The importance of easy access to the central files of the Register was emphasized. Some delegations, referring to health and ecological problems with pesticides in their respective countries, stressed the importance of increased information exchange on such substances, and said that IRPTC should play an increasingly active role in that regard.

(d) Outer limits

155. Several delegations and the representative of WMO referred to plans for co-ordinating the assessment of CO_2-induced climate change and expressed appreciation of the continued co-operation between WMO and UNEP. The need for continued assessment of the climate impact problem was noted, and one delegation urged that it be given priority in WCP, and called for further efforts to produce an integrated CO_2 programme at the next WMO Executive Committee meeting. However, caution was voiced, regarding the danger of over-co-ordination and reservations were expressed concerning the need

for an over-all CO_2 assessment co-ordinating body. One delegation said that the problem was essentially a scientific one, and WMO should therefore take the lead in assessing CO_2. However, another pointed out that UNEP's primary concern was with protection of man and the human environment, and therefore the impact of CO_2-induced climate change was the clear responsibility of UNEP.

156. Two delegations said that given the lack of conclusive evidence concerning ozone depletion, the topic was not one on which the Programme should concentrate. Another delegation, however, observed that despite the differences in interpretation of the scientific evidence, prevention was preferable to cure. The efforts to develop a framework convention accommodation monitoring and assessment activities which would serve to alert the international community to potential threats arising from changes in the ozone layer therefore merited support. Another delegation said that the activities of the Co-ordinating Committee on the Ozone Layer were a very positive means of assuring a sound scientific basis and the production of rigorous scientific assessments.

(e) Environmental data

157. One delegation stressed the need for a unified methodology to set up a data bank on the state of the environment.

3. Environmental management

(a) Environmental aspects of human settlements planning and health of people and of the environment

(i) Environmental aspects of human settlements planning

158. Some delegations stressed UNEP's supportive role in the environmental aspects of human settlements planning. One expressed concern that the present co-operation between UNEP and UNCHS (Habitat) was not fully in line with General Assembly resolution 32/162, which defined the modalities of such co-operation. Another indicated its Government's intention to host, in collaboration with UNEP, a seminar on technical and management aspects of handling, transport and disposal of solid waste especially for developing countries.

(ii) Human and environmental health

159. Some delegations stressed the importance of developing countries controlling and limiting importation of plant treatment agents, which might be hazardous to human health. Several expressed support for the pest management programmes, and stressed the need to accelerate UNEP's catalytic role in that area. Some delegations stressed the need to link the outcome of the Ad Hoc Meeting of Senior Government Officials Expert in Environmental Law (Montevideo, 1981), particularly in respect of the trade in toxic chemicals, and the activities of IRPTC with the pest management programme.

Questions for Bruce A. Ross-Sheriff

To answer your questions we sought information on GEMS and UNEP funding. We had a prompt reply from the UNEP-Washington Liaison Officer, but the data she supplied are rather general. More specific information from Nairobi has not yet arrived. Perhaps this is because UNEP is just now working out how it will deal with its funding problems and the situation is still unclear even in Nairobi. When more specific information arrives from there, we will pass it on to Dr. Greene. Meanwhile, here is a summary of what we have learned, organized according to your questions.

1. The Global Monitoring System (GEMS), organized by UNEP, is planned for program expansion which would enhance the accuracy of deforestation and monitoring data and address more specific resource management efforts. At the same time however, the proposed U.S. portion of the UNEP budget for FY 1983 has decreased 38% over FY 1982 levels and 70% over FY 1981 level.

1A. What percentage of UNEP funds has the U.S. traditionally provided? What nations compose the remainder of funds and how do the individual percentages compete with the U.S.?

Some 96 nations contribute to the UNEP Environment Fund. UNEP's policymaking body, the Board of Governors, comprises 58 nations. The largest contributors, with their proportion of total 1978 to 1981 contributions indicated in parentheses, are: United States (32%), USSR (13%), Japan (11%), Germany (8%), Sweden (6%), France (5%), United Kingdom (4%), Norway (3%), Canada (3%). The USSR contribution included nonconvertible currency, so is presumably less useful to UNEP than the high percentage figure would

suggest. Several other European nations make important contributions. Among the LDC's, the largest contributors in the 1978 through 1981 period included: Kuwait (0.4%), Mexico (0.4%), India (0.3%), Iran (0.3%), China (0.3%), Iraq (0.2%), Venezuela (0.2%), and Argentina (0.2%).

1B. What effect will the U.S. decrease in funding have on GEMS? Have other countries likewise decreased funding for UNEP and subsequently to GEMS?

From 1978 through 1981, the U.S. contributed $10 million per year. In 1982, the U.S. contribution was reduced to $7.85 million. Had other nations not increased their contributions, this would have resulted in a 7% decrease in total funding for UNEP. Other nations did increase their contributions, however, and the 1981 funding was about the same as for the previous years, in nominal dollars. (Because of inflation, the real funds did decline.) The amount of the U.S. contribution in 1983 is not yet resolved. For several years the administration has proposed a lowered contribution and Congress has chosen to restore the amount to a higher level. This year the administration is asking for $3 million. The contribution seems likely to be either $3 million or about $7 to 8 million. If it is the latter figure, and if the other nations also remain even in their contributions, the cut for UNEP will again be limited to inflation. If the U.S. contribution is $3 million, and if the others do not increase their funding this time, there will be about a 16% reduction in UNEP's funding, plus whatever inflation effect occurs -- perhaps that would be another 8%.

1C. What effect will decreased funding to UNEP and GEMS have on the environmental quality of the World?

As of the last full meeting of the Governing Council, UNEP had not decided how it will cope with a sharp reduction in funds. The various

programs, including GEMS, have not been ranked to determine which should be cut by how much. The U.S. contribution is to the general fund, which is allocated among the various UNEP programs according to the decisions of the Governing Council. The GEMS budget is "just over" $2 million. (We do not have a more precise figure for you yet.) That is about 7% of the total UNEP budget. Unless some hard decisions are taken by the Governing Council, the funding cuts that might occur as a result of the decreased U.S. contribution would probably be spread proportionately among the programs, including GEMS. There is an interim meeting of the Governing Council occurring now, but many member nations of the Council have not sent delegations, so whether the necessary decision can be taken at that meeting is not clear. The U.S. delegation is due to return soon.

We don't know how the GEMS program would be affected by a 16 to 25% cut in funds -- that is, a reduction from $2 million to about $1.6 million. The GEMS staff is already modest (three scientists, two administrators, four secretaries), but presumably could be cut. GEMS spends about $120,000 per year on consultants, so not much of the fund cut could be absorbed there. Probably GEMS would stop initiating new programs but would continue the coordination role and some of the technical support role for the monitoring programs now under way. We have not yet learned how important UNEP funds are to continuation of GEMS programs that are under way, such as the tropical forest inventory effort at FAO. The UN agencies do have a reputation for not welcoming much input from other agencies when the input does not include at least some program funds.

1D. What is the relationship between U.S. contributions to UNEP-GEMS and Federal research programs in the area of CO_2, forest resource management, soil erosion, etc. How will changes in GEMS programs affect U.S.-Federal S&T research?

The data generated from GEMS programs have not yet been critically important to many U.S. Federal research programs. This is partly because there are not many U.S. research programs using global environment data, and partly because the GEMS projects have not been under way for long. As far as I know, ours is the only Federal research effort using the GEMS forestry data as they relate to forest resource management. The Federal efforts to develop an understanding of changes in atmospheric CO^2 levels do need to use data on tropical forest changes, and the GEMS data are the best for the purpose. Also, the Background Air Pollution Monitoring Network organized by GEMS (lead agency is World Meteorological Organization) has provided important data on CO_2 levels in remote areas. These are the data against which the more easily obtained data for the industrialized nations are compared, and they are a small but important part of the data needed to understand the dynamics of atmospheric CO_2. As far as we know, there are no Federal programs that are making use of the soil erosion or other soils data generated by GEMS projects.

Certainly the Tropical Forest Resources Assessment Project data are very important to the OTA assessment. FAO was the lead agency for this GEMS project. Perhaps FAO would have done it even if UNEP had not existed, but I doubt it. FAO, like many other agencies, is approaching its work differently now -- taking a broader view of resources and environment -- than ten years ago. This change is due in large part to the efforts made by and through the United Nations Environment Program.

2. On page 2 of your prepared statement, you indicate that although the deforestation data base is not totally "sufficient," it has improved substantially since the late 1970's.

2A. What research/resource is needed to improve data on how the various tropical environments affect groundwater aquifers, silt loads, streamflow, etc. Is there any information the U.S. has on temperate forest research in these areas that could be exchanged with foreign nations?

The data to better understand in general how streamflow relates to vegetation cover (forested vs. grass-covered watersheds, for example) do exist for several of the major tropical river systems. For rivers such as the Nile, Mekong, Ganges, Indus, and Amazon, there are detailed streamflow records for the main rivers, there is some time-series LANDSAT imagery (though less than is commonly thought) to indicate vegatation change, and in the past decade data on rainstorm and snowmelt patterns have been improving. What is lacking is synthesis research to pull these data together and analyze them.

However, to develop site-specific models of relationships between tropical environment and hydrology will require a lot of original field work. Many of the models developed in the temperate areas, such as the "universal" soil loss equation, do not give accurate predictions for tropical situations. This is because rainfall and other natural forces are much more intense and soils are typically more highly weathered in the tropics than in the U.S. farmland and rangeland environments where these models have been developed. Very little of the necessary field work is being conducted.

Science done in the U.S has not developed many data that can explain the environment-hydrology relations in the tropics, but it has developed methods for conducting research, methods for analyzing data, and methods for modeling that can be very usefully adapted to tropical situations. What resource is needed to transfer this technology? Our OTA assessment is seeking an answer to this question. We haven't found it yet and I cannot promise that we will, but it looks as though increased funds for research will not suffice. Some restructuring of the way development projects are designed, to include more

research and evaluation components at the expense of other components, seems to be necessary. I hope our assessment report due next spring will provide a better answer to this question.

2B. Explain the use of LANDSAT in improving data quality. Can this U.S. satellite program benefit GEMS specifically for those tropical nations not presently receiving satellite information?

Many of the data now available on tropical forest resources are based on inaccurate estimates. When LANDSAT and other remote sensing data are applied, the results often indicate a very different situation than what had been understood. The revelation in the late 1970's of very rapid deforestation rates in Thailand and the Philippines by AID-assisted studies using LANDSAT data are examples. In other cases, analysis of LANDSAT data has revealed that the forest resources have more potential for development than had been thought. This was the case with some of the FAO-assisted studies that used LANDSAT data on West African nations. The major inventory of tropical forest resources before LANDSAT data analyses were available was published by Persson in 1975. That report estimated that 55 percent of the best information on tropical forest areas had an accuracy of less than 40%! Forest area data now available from LANDSAT and other remote sensing methods has accuracy more nearly 90%. Obviously, resource use policies and management plans can be much more appropriate with this kind of improvement in the resource inventory data.

Indeed, the LANDSAT program can and is benefiting GEMS for the nations that do not yet receive satellite information directly from NASA. The FAO work in West Africa and the USAID projects in Southeast Asia and East Africa are excellent examples of successful transfer of the LANDSAT technology.

3. On page 3, you state that information is not available for places where the land is forested but productivity rates are changing substantially.

3A. Where are these forested areas where the productivity is substantially changed? What factors are contributing to this change?

The tropical forests include some 730 million hectares of relatively dry "open woodlands," that is, land where the tree canopies cover more than 10% of the ground but not enough of the ground to shade out all grass. Most (485 million hectares) of this is in Africa, but there are also substantial areas of open woodland in tropical India, Southeast Asia, and South America. The productivity, not only of the wood resource but also of the soil and herbaceous resources, is being degraded in nearly all of this open woodland area, in some places rapidly and in others more gradually. The causes are a combination of fuelwood gathering, livestock damage, and fire. The data on open woodland area are much less accurate than the data on closed forests, and the changes that occur are usually difficult to perceive on remote sensing imagery. The problem is most severe in India and in Africa. Around large cities the degradation is so severe that it becomes deforestation -- that is, the tree cover is reduced to less than 10% and it is noticed and recorded by the government agencies. In more remote areas, its extent is unmeasured.

Closed forest areas are more humid and the woody vegetation generally recovers more quickly in places where wood cutting is not followed by clearing for agriculture. Thus subsistence wood cutting is not likely to degrade the productivity of the wood, soil, and herbaceous cover. However, commercial cutting often does result in degradation of the wood resource productivity. This is most apparent in the tropical conifer forests, which are mostly in tropical America. (There are about 24 million hectares of conifer forest in

tropical America, 1 million in tropical Africa, and 8 million in tropical Asia.) It is also common for dipterocarp forests of Southeast Asia to be severely degraded by logging. (In dipterocarp forests a very high -- by tropical standards -- proportion of the trees have commercial value. Thus cutting is more destructive of the remaining forest, and without management it nearly always causes severe degradation.) Although the dipterocarp forests occur only in Asia, there are broadleaved forests in Panama, Columbia, and some other regions where a high proportion of the trees have commercial value and where industrial logging typically causes degradation of productivity.

3B. What management practices are necessary to protect these resources?

A variety of management practices exist that can be practiced within the forests to sustain continuous productivity. However, we have learned of no techniques to harvest commercially significant quantities of wood and at the same time protect the resource diversity characteristic of undisturbed forests. An AID-sponsored research project in Peru is trying to develop such a management technology.

The most important management efforts to protect the natural forests will probably occur outside the forests, on land that has already been deforested. That is, where agriculture is made more productive the pressure for deforestation can be reduced, and where plantations can produce wood more cheaply than it can be got from the remote natural forest, the logging pressure will be reduced.

It appears that for many nations the only management approach that can protect the natural forest will be establishment, protection, and use of

parks. "Use" is a key word here, since if they are not used they are not likely to be sustained for long. But the technologies for using parks in the tropics are not well developed.

4. In your prepared statement (pg. 6), you discuss the importance of the role of social and economic factors on tropical deforestation.

4A. Over the last decade, how would you evaluate changes in the level of awareness and concern of Central America, West and South Africa, and Asian nations to the degradation of tropical forest resources?

There has been a very significant increase in the level of awareness and concern among citizens and officials of the tropical nations about degradation of tropical forest resources. Some of this can be attributed to the efforts of the U.S. State Department. A lot of it is concern that foreign students developed while studying in the United States and Europe in the 1970's. They carried this concern back to their tropical universities, bureaucracies, and political systems and made significant language changes in national policies. Much of this was based on youthful idealism. Whether it will be sustained and whether the stated policies will have strong impacts on current trends is yet to be seen. It seems likely that the environmental awareness that has begun will not survive long without continuing support from the industrialized nations.

4B. How can the need for social science research and biological research on deforestation be meet in a mutual advantageous, complementary manner? In your opinion, what would be the response of foreign nations (where tropical deforestation is taking place) to U.S. participation in social and economic research?

I expect to be better qualified to suggest how the social science and biological research can be done when the current OTA assessment process is

complete. At present, it appears to me that the best approach for U.S. participation is to support the research institutions that exist in the nations where deforestation is occurring and to develop strong research and evaluation components in development programs. Some of this can be done through UNEP and other multilateral organizations, but a lot of it will have to be done through bilateral arrangements.

The study of deforestation (vs. reforestation) is more likely to be done by academic institutions or institutions such as the National Science Foundation than by forestry-oriented institutions. It is more likely to be done by geographers, anthropologists, and rural sociologists than by foresters or biologists. It is basic, not applied, research. Yet until the processes of deforestation are well understood, the applied efforts to deal with forest resource management are unlikely to succeed, mainly because development projects will not be designed to solve the actual problems but rather to deal with some symptoms.

In my experience, foreign nations are very open to U.S. participation in social and economic research <u>if</u> the reserach is done on their terms. Unfortunately, our arrogance sometimes gets in the way of accepting their terms.

CHARTER

Joint Hearing on Deforestation: Environmental Impact and Research Needs

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH, AND ENVIRONMENT
of the
COMMITTEE ON SCIENCE AND TECHNOLOGY
and the
SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS
of the
COMMITTEE ON FOREIGN AFFAIRS

September 16, at 9:30 a.m.
Room 2200 Rayburn House Office Building

I. Objectives

1. To examine the status of research on the environmental and agricultural impacts of global forest degradation and loss.

2. To determine the status of the research necessary to minimize the adverse impacts of forest degradation and to provide viable alternatives.

3. To explore the role and direction of the United States' efforts in providing assistance in deforestation issues.

II. Background

The tropical moist forest is recognized as one of the most extensive but least known ecological regions on Earth. These forests are disappearing at an alarming rate as the world's increasing population clears and converts forest lands in an effort to grow more food, to cut wood for fuel, and to harvest trees for industrial raw material.

The Subcommittee on Human Rights and International Organizations (HRIO) held three days of hearings in Tropical Deforestation beginning on May 7, 1980. Testimony given indicated that since 1950, fifty percent of the world's forests have been cut down or burned. The current rate of forest removal is approximately twenty-seven million acres per year. This is roughly equivalent to the total forest acreage in the State of Georgia or in the State of Oregon. Projections given during the HRIO Subcommittee hearings indicated that unless governments take coordinated actions, much of the world's tropical forests will be scattered and highly degraded remnants soon after the year 2000.

III. Impact of Accelerated Deforestation on Developing Countries

Accelerated loss or degradation of large areas of forest causes numerous environmental as well as societal and economic problems. The impacts on the environment can be severe. Intensified seasonal flooding with a resulting loss of lives and property, accelerated erosion of agricultural lands, siltation of rivers and harbors, water shortages in dry years, and disappearance of plants and animal species and loss of habitat at unprecendented rates are major consequences of deforestation. One of the most striking examples of the impact of deforestation is found in Haiti. Historically, this country possessed some of the most fertile and productive lands in the Western Hemisphere. However, recent decades of forest land conversion to other uses and of timber harvest without adequate reforestation have resulted in severe erosion and land that cannot produce an adequate supply of food to support the population of the country. The severity of the problem in modern times is further exacerbated by overpopulation, lack of technical advancements, and political insensitivity to the protection and restoration of land productivity.

IV. Impact of Deforestation on the United States

In the United States the tropical forests represent less than one percent of the world's total. Even though deforestation occurs primarily in developing countries, developed countries are not escaping the adverse effects. For example, the pharmaceutical industry depends to a large degree on tropical plants as a source of ingredients. One-fourth to one-half of the prescriptions in the United States contain ingredients from tropical plants. However, in testimony presented at the HIRO Subcommittee hearings, it was estimated that tropical forest depletion has resulted in the loss of from two to five million of the world's species. Thus, both the current supply and the future drug potential is seriously jeopardized.

Another ramification of the loss of species is found in the area of agriculture productivity. American agriculture needs frequent infusions of genetic material from tropical plants in order to meet increasing demands in productivity, pest resistance, drought resistance, etc. As species are lost the needed genetic diversity is also lost.

V. Climatic Impact

On a global basis, the stability of the climate may be disrupted by deforestation. In a July 31, 1981 hearing on Carbon Dioxide and Climate, by the Natural Resources, Agriculture Research and Environment Subcommittee, the link between deforestation and the increase in atmospheric concentrations of carbon dioxide was clearly established. A followup hearing, held on March 25, 1982, indicated that two major factors are involved in the contribution to atmospheric carbon dioxide. The first

is the addition of carbon dioxide to the atmosphere that occurs when forests are cleared by burning. This is a common practice if the land is to be used for farming which is often at a subsistance level, the major cause of deforestation. The second factor is the loss of trees which could remove carbon dioxide from the atmosphere by photosynthesis. The net effect of these two has lead to the increase in atmospheric levels of carbon dioxide at a rate of over one billion tons annually. Even though this is an alarming rate, most of the carbon dioxide emitted as a result of man's activities comes from fossil fuel combustion. The total increase in atmospheric carbon dioxide concentration could significantly alter the world's climate including major changes in temperature and rainfall patterns.

VI. Hearing

The status of research needed to understand the scope of forest alteration and the resulting environmental impacts will be a major focus of the hearing. Also, the direction and level of effort of the United States towards national and international programs in deforestation will be examined.

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RATE OF LOSS OF TROPICAL FORESTS

In 1980 I prepared Conversion of Tropical Moist Forests, a report for the U.S. National Academy of Sciences. Also in 1980 I wrote a paper dealing with the same subject for Environmental Conservation. In these two publications, I concluded that, as a best-judgement estimate, tropical moist forests are being converted from their primary state at a rate of around 200,00 sq. kms. a year.

In 1981, FAO and UNEP published the three-volume report of their Tropical Forest Resources Assessment Project, which concluded that the forests are being eliminated at a rate of 73,000 sq. kms. per year.

Some observers ask why there is such a difference between the two figures. The apparent discrepancy lies with the two sets of criteria used. In my own case, the U.S. National Academy of Sciences required that I look at rates at which primary forests are being converted from their original state into some other state. The process of conversion can result in disturbed forest, or regenerating (secondary) forest; or it can result in forest being cleared away entirely and permanently. The Academy asked me to take, as my base line, primary forest--altogether different from "forest of any kind". The Academy made this stipulation because it was interested in biological values at issue, rather than other factors such as forestry (timber) values and exploitation potential of forestlands for e.g. agriculture.

The FAO and UNEP project adopted a different approach. Since it was concerned with forestry and agricultural values rather than biological values, it considered that a disturbed forest remains a forest, even if it has been subjected to heavy exploitation through timber harvesting, for example, which in certain Dipterocarp forests can mean that only one quarter of the above-ground biomass remains alive in the wake of the harvester's activities. After all, say FAO and UNEP, if the forestland has not been given over to rice cultivation or a rubber plantation or some basically different type of land use, the forest is still a forest. While incapable of returning to a primary state, with its exceptional biotic richness, for decades or even centuries, the forest still constitutes forest.

The FAO/UNEP project also postulated, reasonably enough within the context of its objectives, that a man-established plantation of a mono-culture such as eucalyptus amounts to a forest--albeit with very different biological characteristics from those of an undisturbed natural forest.

In short, my study looked at significant modification of primary forests. The FAO/UNEP study focused instead on outright elimination of forests. Hence the difference in the two sets of figures presented as the main conclusion of the two reports.

Since completing my work for the Academy, I have come up with a figure for outright elimination of forests, of 115,000 sq. kms. per year. While this is higher than the FAO/UNEP figure, it is in the same "ball park."

Dr. Norman Myers
September 20th 1982

Indicative Summary Of Multilateral And Bilateral Support To Forestry And Forestry Research

(Ongoing Projects, As Of January 1982) 1/

Region	Total Number Of Projects	Number Supported by AID	Total Support ($ Million)	Research Component ($ Million)
East Africa	67	8	$254.7	$20.3
West Africa	80	28	$264.6	21.3
Latin America and Caribbean	130	19	$396.6	46.8
East Asia and Pacific	67	10	$164.9	35.0
South Asia	72	26	$430.9	13.5
East Med. and and Near East	31	8	$189.7	6.8
TOTAL	447	99	$1701.4	$143.7

1/ Compiled from a project inventory prepared by the World Bank and FAO for the Sixth Session of FAO Committee on Forestry, May 1982, Rome.

INDICATIVE SUMMARY OF MULTI LATERAL AND BILATERAL SUPPORT TO FORESTRY AND FOREST RESEARCH IN DEVELOPING COUNTRIES
JANUARY 1983

ANNEX I

Region	Country	Supporting Agency	Years	Type of Project[1/]	Approximate Total of[2/] Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
East Africa	Botswana	USAID	1980-84	Forestry Component in RD Project	0.1	"	"
		"	1980-82	Woodlot Component in Renewable Energy Technology	0.1	"	"
	Burundi	Belgium	1980-81	Research in Kisozi Section and also co-financing to other areas	1.-	Reforestation activities	5.4
		IBRD	1979-84	Fuelwood Poles and Commercial Plantations	4.3	"	"
	Ethiopia	Sweden (SIDA)	1975-81	Sector Support	16.0	Wood Preservation	"
		" (SAREC)	1981	Village Forestry	2.1	S-o-infected Recreation	1.-
		FAO	1978-83	Assistance to Forestry Research	0.4	Silvicultural Research - seed [illegible] Phase III Genet Institute	0.1
	Kenya	Australia	1976--	Woodlots in Land Settlement Scheme	4.0	Species and Establishment Trials	0.1
		Canada (CIDA)	1978	Forestry Sector Study	0.1	Species study of afforestation, [illegible] industries, education and training, other sub-sectors	"
		" "	1979	Wildlife Planning Unit	2.4	Conservation of wildlife resources, conference and training units	0.1
		Canada (IDRC) " "	1975 1975-81	Afforestation Agro-silvopastoral (ICRAF)	0.2 1.5	Species Trials on national lands Agro-forestry Systems Research	1.- 1.5
		Norway	1981--	Social Forestry	-	Species and Establishment Trials	1.1
		USAID	1980-81	Agro-forestry in Renewable Energy Project	[illegible]		
			1978-81	Forestry Component in Arid Lands Development Project	0.1		1.9
		FAO	1978-81	Forest Fire Management	0.1	"	"
		IBRD	1975-81	Commercial Plantations	0.2	Tree Improv.	0.1
			1977-82	Rural Fuelwood Development (continued and Poles	23.0	Species and Establishment Trials	0.1
					0.1	"	"
	Madagascar	Norway	1978	Satellite feasibility study	0.1	"	"
		IBRD	1975-79	Commercial Plantations	11.5	Species and Establishment Trials	"
			1981-85		20.0	Genetic, Growth and Yield Trials	0.1
	Malawi	Canada (IDRC)	1978--	Fuelwood Plantations	0.2	Species/Provenance and Establishment Trials	0.1
		IBRD	1980-85	Fuelwood	13.8	"	"
	Mozambique	Norway	1981	Wood Impregnation Plant	-	"	"
		FAO	1977-86	Forestry and Forest Industries Development	7.2	Forest Management	0.1
	Rwanda	USAID	1976-81	Forestry Education in Management	0.1	"	"
		IBRD	1980-85	Fuelwood, Poles and Commercial Plantations	21.0	"	"
	Seychelles	Norway	1978	Small Scale Sawmill Facility Study	0.1	"	"
	Somalia	USAID	1979-84	Forestry Component in Rangeland Development Project	0.1	"	"
		IBRD	1980-85	Windbreaks - Central Rangelands Project	1.0	"	"
	Sudan	Canada (CIDA)	1982	Wood Products Demand Study	0.4	"	"
		" "	1982	Blue Nile Wood Utilization Unit (Sudd)	2.4	"	"
		" "	1982	Bahr El Ghazal Wood Utilization Units (Sudd)	1.0	"	"
		" "	1982	Bahr El Ghazal Forest Inventory Project	2.0	"	"
		" "	1982	Blue Nile Forest Inventory Project	0.5	"	"
		" "	1982	Forestry Sector Coordinator	0.8	"	"
		" "	1982	Fortune (In planning Stage)	1.6	"	"
		Canada (IDRC)	1975--	Irrigated Shelterbelts in Desert	0.2	Land Re. [illegible] Trials	"
		" "	1978	Provenance Trials	0.2	Provenance Trials - Baseline [illegible] nutrition	0.1
		Finland	1979--	Afforestation - Blue Nile Province	1.3	Nursery and Establishment Trials	"
		Sweden (SAREC)	1980	Soil/Silviculture	0.2	Soil/Silviculture	"
		USAID	1981-85	Firewood Component in Renewable Energy Project	0.1	Trials	"
		IBRD	1977-82	Fuelwood in Savannah Development Project	0.1	"	"
	Swaziland	Canada (CIDA)	1978	Technical Assistance in Forestry	0.1	"	"

Region	Country	Supporting Agency	Year	Type of Project[1/]	Approximate Total of Loan/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
East Africa (Contd)	Tanzania	Canada (CIDA)	1977	Tabora Rural Development Project	0.1 (fraction of larger project)	-	-
		Canada (IDRC)	1970	Chatlod Stevens	0.1	Improved Stove Trials	0.1
		" "	1970	Afforestation	0.1	Species Trials for Afforestation	0.1
		Finland	1981--	Zanzibar Afforestation Program	0.5	Nursery and Afforestation Trials	0.1
		Germany (FTZ)	1981-1983	Agro-Forestry Erosion Control	0.1	Trials	0.1
		Norway	1976	Establishment of Forest Universities Facility	5.0	Tropical Research Involvement	1.0
		"	1976	Large Scale Sawmill and Logging	4.0	Wood Properties and Treatment	1.0
		"	1980	Large Scale Sawmill Feasibility Study	-	(Not yet effected)	-
		Sweden (SIDA)	1975-81	Forestry Sector	14.0	Silviculture and Wood Utilization	2.0
		" (SAREC)	1976-81	"	0.5	Soil/Silviculture	0.2
		USAID	1981	Village Woodlots in Environmental Project	0.1	"	"
		"	1976-82	Nursery Development in Regional Development Project	0.1	"	"
		IBRD	1976-81	Commercial Plantations	3.0	Species and Establishment Trials	1
		"	1977-82	Tunlumod in Tobacco Project	0.1	"	"
		"	1978-83	Tunlumod and Polad in KK Project	1.0	Species and Establishment Trials	0.1
	Zaire	Belgium	1980-81	Energy - Charcoal and Kerosene	-	Wood Energy Development	-
		Canada (CIDA)	1977	FORESCOM - Logging and Sawmill Equipment	16.1	-	-
		" "	1976	Forest Inventory Project	1.5	-	-
		" "	1980	ECOGAMENA - Training School for Forest Technicians, advisors and equipment	0.2	-	-
		" "	1980	Forestry Training for Professional Foresters	1.4	-	-
		" "	1982	IFIAF - Forest Inventory Service	3.3	-	-
		" "	1977	Wood Preservation Centre	0.1	Feasibility study for establishment	-
		" "	1982-87	Six national Projects	0.1 - 1yr; 68.1	-	-
	Zambia	Finland	1975--	Forest Products, Genetics, Extension Training	1.2	Support to Training Project	-
		IBRD	1977-82	Commercial Plantations	13.3	-	-
	Zimbabwe	Canada (IDRC)	1981--	Silviculture	0.2	Species Trials in wild [illegible]	-
							-
	Regional	Norway	1972-80	Support to SA Forest Research Institute	1.3	Species and Establishment Trials	0.3
		UK	1975-77	Research Support	-	Seed Sources and Genetic Improvement of Pines	-
		USAID	1978-81	Natural Resources Survey	0.1	-	-

Region	Country	Supporting Agency	Year	Type of Project[1]	Approximate Total Aid Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
West Africa	Benin	Germany	1980-87	Teak Management, Afforestation, Planning	3.5	Inventory and Fuelwood Plantation	0.2
	Cameroon	Canada (CIDA)	1979	Institutional Support	3.2	-	-
		" "	1981	Photo-mapping Process (Aerial Photographs)	4.1	-	-
		" "	1982-87	General Forestry Assistance	12.5	-	-
		Canada (IDRC)	1977--	Agro-forestry	0.5	Species Trials with Leucaena trees	0.2
		Germany (GTZ)	1978-10	Schooling in Game Management	1.5	Game Management	0.4
		IBRD	1981-86	Pilot Plantations and Fuelwood in Northern RD Project	4.9	Species and Establishment Trials	1.0
			1981-86	Commercial Plantations and Management	17.0	Species and Provenance Trials	0.3
	Cape Verde	Belgium	1980-81	Desertification Control	1.4	Plantation Techniques	0.1
		USAID	1980-84	Forestry Component in Watershed Management Projects	0.6	-	-
		"	1975-81	Foregstry Component in RD Project	0.1	-	-
	Chad	FAO	1975-78	Afforestation Programme	0.6	Afforestation	0.1
		IBRD	1978-83	Fuelwood in RD Project	0.1	-	-
	Gambia	Germany (GTZ)	1978-81	Inventory and Trials	1.1	Species and Establishment Trials	0.4
		Norway	1977-80	Support to EA Forest Research Institute	0.1	Species and Establishment Trials	0.1
		USAID	1976	Production, Utilization and Extension	1.0	-	-
	Ghana	Canada (CIDA)	1980	Northern Region Integrated Rural Development	3.6	-	-
		Canada (IDRC)	1977--	Agro-forestry	0.3	Insect-Fungus and Soils Research	0.1
		Germany (GTZ)	1976-81	Training and Research in Wood Technology	1.4	Wood Technology	0.3
		FAO	1976-83	Development of Energy Resources	1.2	Renewable Energy	0.3
	Guinea	Canada (CIDA)	1982-87	Natural Forestry Resources (Five Projects)		Establishment of Forest Inventories within Rural Development Project	0.4
		USAID	1981	Community Forestry	1.-	-	-
	Guinea Bissau	USAID	1982	Forest Management	2.1	-	-
	Ivory Coast	IBRD	1979-84	Commercial Plantations	16.0	Protection and establishment trials	1.0
	Liberia	Germany (GTZ)	1975-81	Commercial Plantations and Management	5.9	Harvesting and Reinforest Management	1.0
		IBRD	1979-84	Management, Trials, Commercial Plantations	6.2	Species and Establishment Trials	1.0
	Mali	Canada (CIDA)	1978	Kaarta Rural Development	-	Provision for establishment of forest inventories within Rural Development Project	1.0 (portion of this amount)
		Canada (IDRC)	1978--	Savannah Timber	0.1	Wood Properties and Processing	0.1
		" "	1981--	Irrigated Plantations	0.2	Species/Provenance Trials	0.1
		USAID	1980	Village Reforestation	0.5	-	-
		"	1981-84	Village Forestry in Renewable Energy Projects	0.6	-	-
		"	1977-81	Forest Inventory in Land Use Project	0.1	-	0.1
		IBRD	1975-80	Fuelwood and Poles in Livestock Project	0.1	-	-
		"	1979-84	Fuelwood/Poles Plantations	4.5	-	-
	Mauritania	USAID	1978-82	Forest Component in RD Project	0.2	-	-
		"	1978-85	Dune Stabilization in Resource Management Project	1.4	-	-
		"	1981-86	Dune Stabilization in Resource Management Project	1.0	-	-
	Niger	Canada (IDRC)	1980--	Village Woodlots	0.7	Species and Establishment Trials	0.1
		USAID	1980	Forestry and Land Use Planning	1.0	-	-
		"	1976-82	Forestry Components in RD Project	0.1	-	-
		"	1981-85	Forestry Components in RD Project, Phase II	7.2	-	-
		IBRD	1975-80	Fuelwood in RD Project	2.1	-	-
		"	1978-83	Fuelwood and Poles Plantations	4.5	-	0.-
	Nigeria	Canada (IDRC)	1975--	Shelterbelts	0.1	Species and Establishment Trials and Economic Evaluation	0.1
		" "	1977--	Savannah Plantations Effects and Ameliorations		Land Productivity Trials, Farm Systems Trials	0.1
		" "	1977--	Agro-forestry - LITs	0.1	Farming Systems and Soil Fertility Trials	0.1
		" "	1981--	Agro-forestry - LITs	0.1	Farming Systems and Soil Fertility Trials	0.1
		Germany (GTZ)	1980-82	Research in Wood Technology	0.2	Research in Wood Technology	0.1
		FAO	1976-87	Development of Forest Management	1.4	Tree Improvement-Genetics	1.0
		IBRD	1977-82	Fuelwood and Poles in Area Development Project	2.1	-	-
		"	1979-91	Commercial Plantations	31.0	Species trials with Pine	1.0
		"	1981-86	Fuelwood and Poles in Rain Afforestation Development Project	4.7	Land Reclamation Trials	1.0

Region	Country	Supporting Agency	Year	Type of Project[1]	Approximate Total of Loan/Credit/Grant (US$ million)	Resource Component	Approximate Research Amount (US $ million)
West Africa (Contd)	Gabon	Canada (CIDA)	1982-87	Doctoral Study Energy, Reforestation, Desertification	To be determined	"	"
						"	"
	Senegal	Canada (CIDA)	1982	Fire Protection Phase II	0.1	Selection and improvement of Gonakie Gumgum	0.1
		Canada (IDRC)	1980--	Gum arabic	0.5 >	Land Recovery Trials	0.1
		Finland (FaD)	1981	Afforestation		Species and Establishment Trials and Biomass Yield	1.3
		Germany (GTZ)	1975-83	Range Management, Fuelwood, Agro-Forestry	3.4	Sand Dune Fixation Techniques	0.6
		FAO	1976-81	Sand Dune Fixation	1.1	Protection Development and Desertification control	0.5
		"	1979-81	Forest Development	1.8	"	"
		"	"	"	"	"	"
		ISA/2	1980	Village Woodlot Development	0.1	"	"
		"	1979-82	Semi-Arid Inventory and Development	2.1	"	"
		"	1979-83	Forestry Component in Livestock Production Project	0.6	"	"
		"	1981-82	Forest Resource Assessment	2.0	"	"
		"	1982	Shelterbelt Development	0.5	"	"
		"	1979-83	Fuelwood Production	3.1	"	"
		"	1980	Village Woodlot Development	0.1	"	"
		1880	1976-81	Fuelwood and Windbreaks in 6D Project	0.1	"	"
		"	1981-86	Fuelwood, Poles, Management	0.1	Species, Establishment Trials, Management	1.0
	Togo	FAO	1978-86	Afforestation (Kara)	1.5 >	Desertification Control	0.6
	Upper Volta	Canada (CIDA)	1982-87	Anti-Desertification	12.5 (Estimated)	"	"
		Germany (GTZ)	1974-83	Reforestation, Management, Fuelwood	7.4	Species and Establishment Trials, Range Management, Soils	1.1
		"	"	"	"	Agro-Forestry Forests	1.4
		FAO	1973-86	Forest Resources Development	"	"	"
		UNSO	1977-82	Forest Education in Horticulture/ Building Project	0.7	"	"
		"	1979-82	Forestry Component in 6D Project	0.1	"	0.1
		"	1979-81	Forestry Training and Management	6.2	Trials	"
		"	1976	Agro-Forestry	3.1	"	"
		"	1979	Community Forestry	0.1	"	"
		UNDP	1980-81	Fuelwood, Poles and Management	15.1	Management of Forests Trials	"
		"	"	"	"	"	"
	Zaire	UNDP	1979-80	Wildlife Research Survey	1.1	"	"
		Italy	1981-84	Forest Inventories in Ituri River Basin Planning (Small)	1.1	"	"
		UK	1975-82	Hardwood Improvement		Preservation and Protection Trials	"

Region	Country	Submitting Agency	Year	Type of Project	Approximate Total of Loan/Credit/Grant (US$ million)	Research Component	Total Value of Research Component (US $million)
East Asia and Pacific	Burma	Canada (CIDA)	1972	Wood Preservation Treatm	0.1	Testing of Wood Preservative	0.1
		" "	1973	Plant Construction	1.9	"	"
		" "	1978	Technical Assistance	0.2	"	"
		" "	1973-81	Trades training and provision of equipment	1.3	"	"
	China	Australia	1981	Demonstration Planting Proj	1.5	[illegible]	[illegible]
		Canada (CIDA)	1982-87	National Riverine, Protection/Soil Stabilization Industry Development	[illegible]	Soil Science	[illegible]
		Canada (IDRC)	1981--	Bamboo	0.1	Species selection for Fiber/Pulp Uses	0.1
		FAO	1980	Study Tours	0.1	Research Project Study Tours	0.1
		"	1981-82	Research Centre	2.3	Training and Research	2.3
	Fiji	Japan	1981-82	Forest Inventory	1.0	"	"
	Indonesia	Canada (CIDA)	1976	Forest Industry Training Project, Phase I	4.1	"	"
		" "	1981	" " " " Phase II	4.1	"	"
		" "	1980	Planning National Forest Inventory Utilizat	0.2	"	"
		" "	1980	Forestry Training Center	0.1	"	"
		" "	1977	Sulawesi Regional Development Plan	2.3	"	"
		" "	1978	Resources Evaluation Aerial Photography	16.1	"	"
		" "	1976	Forestry Environmental Technical Assistance	0.1	"	"
		Canada (CIDA)	1981	Bamboo Preservation	0.1	Bamboo Preservation Techniques	"
		German (GTZ)	1980-84	Universite Forestry Faculty - Management Wood Technology, Improvement	"	Institutional Strengthening	"
		Japan	1978-82	Logging Technique	"	Logging and Silvicultural Trials	"
		"	1976-84	Afforestation Trials	"	Afforestation Trials	0.1
		"	1977--	Research and Afforestation Trials	"	"	"
		"	1978-80	Forest Inventory	"	"	"
	"	ITA10	1980-84	Forestry Strengthening in Selected Agricultural Research Projects	"	"	"
	"	"	1977-78	Station Forestry in CIFADEV I Project	0.1	"	"
	"	"	1980-83	Station Forestry in CIFADEV II Project	"	"	"
	"	"	1979-83	Forestry Component in Area Development Project	0.1	"	"
	"	"	1974-82	Forest Education in Eastern Islands Agricultural Education Project	0.1	"	"
		UNDP	1978-84	Forestry Training in Agric. Sector Training Project	"	"	"
		"	1980-83	Establishment of Nature Reserve in Irrigation Project	0.1	"	"
		"	1980-83	Strengthening Forest Research Institute in Agricultural Sector Research Project	1.0	Infrastructure and Training	1.0
	Korea	German (GTZ)	1976-81	Farm Forestry, Vocational Training	1.0	Species and Silvicultural Trials, Aerial Photos	0.1
		IBRD	1976-80	Fuelwood and Farm Forestry in RD Project	0.1	"	"
	Laos	ADB	1976--	Log and Extraction Processing	0.9	"	"
	Malaysia	Canada (CIDA)	1976-80	Provision for equipment and instructors	0.1	"	"
		" "	1971-78	Provision for Technical Assistance, Training awards and Equipment in Sawmill Maintenance, Woodworking and Sawmill Ops	0.1	"	"
		FAO	1973-81	Forest Development	1.5	Silvicultural Research	0.1
		UN	1971-77	Research	"	Various Issues Re and Silviculture	"
		"	1975-76	Research	"	Soil/Forest Relationships	"
	Philippines	Canada (IDRC)	1973--	Lauan/Red Meranti	0.1	Nutrient Requirements of Dipterocarp Seedlings and Forage Trials	0.1
		Finland (ILO)	1975--	Labor Intensive Methods in Forestry	0.6	Study and Development Undertaken by ILO	0.6
		Germany (GTZ)	1975-84	Timber Stand Improvement and Training	1.1	Species and Establishment Trials	0.5
		Japan	1976-87	Afforestation Trials and Erosion Control	10.0	Species Trials	0.8
	"	UNDP	1978	Agro-Forestry Component in BICOL Integrated Agricultural Development Project	0.1	"	"
	"	"	1978-80	Agro-Forestry Component in BICOL Integrated Agricultural Development Project	0.1	"	"
		FAO	1971-81	Research and Development	3.0	Climate Research	0.1
		"	1973-81	Training Research in Forest Management	1.1	Research in Forest Management	0.1
		IBRD	74--82	Fuelwood and Poles in RD Project	0.1	"	"
		"	1978-83	Small Farmer Tree Farming and Pilot Commercial Plantations	0.2	Species and Establishment Trials and Soil Stabilization	0.1
		"	1981-86	Watershed Management and Erosion Control	18.0	Watershed Management Aspect Trials	2.0
	Solomon Islands	Australia	1980--	Agro-Forestry (Feasible)	0.8	Tree/Pasture Trials	0.5
		UN	1976-82	Research	"	Entomology	"
		"	1980-81	Research	"	Silviculture	"
	Taiwan	FAO	1980-84	Economics and Inventories	0.1	Forest Management Mgt.	0.1

Region	Country	Implementing Agency	Year	Type of Project[1]	Approximate Total Level/ Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
East Asia and Pacific (Contd)	Thailand	Canada (IDRC)	1981	Rattan	0.1	Survey of Lesser Known Species	0.1
		Denmark	1975-80	Teak Improvement	0.8	Genetic Improvement	-
		"	1975-81	Pine Improvement	0.9	Genetic Improvement and Establishment	-
		"	1975-81	Forest Improvement	0.7	Establishment Trials and Seed Collection	-
		Japan	1981-86	Re-afforestation Research and Training	12.5	Species and Agro-forestry Trials	5.0
		USAID	1979-80	Village Forestry in Renewable Energy Project	0.6	-	-
		"	1980-84	Forestry Component in Highland Area Development Project	2.9	Trials	0.1
		"	1981-88	Village Forestry in N.E. Related Agricultural Development Project	6.3	-	-
		FAO	1973-81	Watershed Management	0.5	Species Trials	0.3
			1981-84	Development of Diversified Forest Rehabilita.ion	1.1	Soil and Silvicultural Research	0.3
		IBRD	1980-83	Watershed Plantations and Farm Forestry in Agriculture Project	2.5	-	-
	Regional Bodies	ADB	1980--	Plantations Development	1.7	-	-
	Viet Nam	FAO	1978-8.	Strengthening Forest Research Institute	2.1	Silvicultural Research	0.1
		"	1978-81	Strengthening Forest Research (Southern)	1.3	Afforestation	0.1

Region	Country	Supporting Agency	Year	Type of Project[1/]	Approximate Total of[2/] Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
South Asia	Bangladesh	Canada (CIDA)	1976	Sangu-Matamuri Forest Development			
		" "	1981	Logging and Sawmilling Feasibility Study	49.5	-	-
				Khulna Newsprint - Rehabilitation and upgrading of mill	6.1	-	-
		Canada (IDRC)	1980--	Bamboo	0.2	Selection and Propagation of High Yielding Varieties	0.2
		ADB	1981--	Fuelwood and Homestead Forestry	11.0	Agro-forestry Research and Preventive Trials	0.1
		FAO	1976-79	Research and Development	1.0	Silviculture and Management Research	0.1
		"	1981-83	Assistance to Forestry Sector	2.7	Production of Forest Products	0.1
		IBRD	1980-85	Mangrove Reforestation	11.0	Species Selection and Establishment	2.0
	Burma	Canada (CIDA)	1977	Wood Preservative Testing	0.2	-	-
		" "	1973	Plant construction	1.8	-	-
		" "	1978	Technical Assistance	1.2	-	-
		" "	1973-81	Timber Bees workshop	0.5	-	-
		Japan	1977-82	Logging Training	5.0	-	-
		ADB	1977--	Logging, Infrastructure and Pre-investm.	15.0	-	-
		FAO	1978-82	Establishment of Forest Research Institute	1.5	Silvicultural Research	0.5
		IBRD	1980-85	Forest Management and Commercial Plantations	15.0	Species and Establishment Trials	0.5
		"	1981-86	Development of Wood Industries	12.0	-	-
	India	Canada (CIDA)	1981	Forestry Sector Study	0.4	-	-
		" "	196.	Andhra Pradesh Social Forestry	4.3	-	-
		Canada (IDRC)	1981--	Silviculture	0.4	Silviculture & study of [illegible]	
		Germany (FCT2)	1980-5	Integrated Regional Development	0.9	Kahin Tandeo Hill/Sk.[illegible]	
		" "	1981-83	Research and Scientific Exchange	0.5	Protection, silviculture, seed and Tree [illegible]	0.1
		Norway	1979--	Social Forestry (not yet effective)	15.0	-	-
		Sweden	1976-82	Forestry Sector	6.3	Silviculture	0.5
		USAID TSA (PL 480)	1981-83	Andhra Pradesh Social Forestry	7.0	Trials	
		" "	1980-1	Research	0.1	Silviculture and Fuelwood [illegible] Species Trials	0.1
		" "	1980-1	Research	0.1	Tree Improvement and Plantations	0.1
		" "	1980-1	Research	0.1	Tree Improvement and Plantations	0.1
		IBRD	1976-81	Pilot Commercial Plantation	4.0	Species and Establishment Trials	0.4
		"	1979-81	Fuelwood and Farm Forestry (UP)	3.0	Diffusion in Field Demonstration and Promotion	0.5
		"	1980-85	Fuelwood and Farm Forestry (Gujarat)	17.0	Species and Establishment Trials	0.5
		"	1981-86	Forestry Operations in Integrated Rural Watershed Development	3.0	Species and Establishment Trials, S. [illegible] Economic Studies, Socio-Forest. Trials	0.5
		"	1981-86	Fuelwood and Farm Forestry (West Bengal)	24.3	Species and Establishment Trials	0.5
	Nepal	Australia	1978--	Fuelwood and Farm Forestry	-	Species and Establishment Trials	-
		Canada (CIDA)	1980	Land Resource Assessment - Provision of aerial photography, photo interpretation and assessment of land use capabilities	1.4	-	-
		" "	1981	Rural Development project	11.0 total	Forestry and education [illegible]	1.0 total
		USAID	1980-83	Forest Management Component of Resource Conservation and Utilization Project	4.5	Trials	0.5
		"	1980-83	Management and Community Forestry Component of RD Hazari Zone Project	1.2	-	-
		UK	1978-82	Research	-	Silviculture Research	
		ADB	1977--	Fuelwood Plantation and Sawmilling	4.8	-	-
		UNFC	1978--	Sisamwood Forestry Development	1.0	-	-
		IBRD	1976-81	Fuelwood in RD Project	0.2	-	-
		"	1980-83	Fuelwood, Farm Forestry and Training	17.2	Species and Establishment Trials	
	Pakistan	USA (PL 480)	1980-1	Research	0.2	Root Nodules in [illegible]	0.1
		" "	1980-1	Research	0.1	Management of Mangrove	0.1
		" "	1980-1	Research	0.1	Poplar Clone selection - Punjab	0.1
		" "	1980-1	Research	0.1	Genetic improvement of Poplars	0.1
		" "	1980-1	Research	0.1	Fertilizer Trials	0.1
		" "	1980-1	Research	0.1	Utilization of low quality wood	0.1
		" "	1980-1	Research	0.1	Wood Preservation of Poles	0.1
		" "	1980-1	Research	0.1	Farm Forestry Species Trials - Sind	0.1
		" "	1980-1	Research	0.1	Poplar Borer Protection	0.1
		" "	1980-1	Research	0.1	Windbreaks	0.1
		" "	1980-1	Research	0.2	Acid Land Utilization	0.2
		" "	1980-1	Research	0.2	Bio-mulch of Saline Lands	0.2
		" "	1980-1	Research	0.1	Tillage Water and Crops	0.1
		" "	1980-1	Research	0.2	Termite Control and Losses	0.2
		" "	1980-1	Research	0.2	Basin Extension Methods - R[illegible]	0.2
		" "	1980-1	Research	0.9	Tree Improvement - Nations Pl[illegible]	0.5
		" "	1980-1	Research	-	Evaluation Soc. Forestry	-
		" "	1980-1	Research	0.1	Soil Conservation Evaluation in Sutlej [illegible]	0.1
		" "	1980-1	Research	0.1	Root Reduction in Sand-dune[illegible] Afforestation	0.1
		FAO	1980-81	Establishment of Field and Farm Laboratory	2.3	Wood Research	0.3
		IBRD	1978-81	Pilot Commercial Plantations	1.0	Species and Establishment Trials	0.5
		"	1978-82	Fuelwood and Poles in Agriculture (Sind)	2.5	Species and Establishment Trials	0.5
	Sri Lanka	Canada (CIDA)	1974-80	Technical Assistance to pulp and paper mill	1.5	-	-
		" "	1979	Provision of log skidders for landclearing	8.6 (portion)	-	-
		Norway	1980--	Watershed Protection, Social Forestry	1.0	Establishment Trials	
		USA	1980-83	Fuelwood and Watershed Management	4.4	Trials	0.7
		FAO	1981-84	Forest Inventory for Management Planning	0.6	Management Plans	0.1
		IBRD	1978-82	Fuelwood in Tree Crop Diversification Project	0.1	-	-
	Regional	Canada (CIDA)	1980	ASEAN Forest Tree Seed Centre	1.1	-	-
		FAO	1979-82	Centre for Forestry Education	1.6	Training,Research [illegible]	

Region	Country	Supporting Agency	Year	Type of Project[1]	Approximate Total Cost/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
CPEC/A	Afghanistan	IBRD	1979-84	Fuelwood and Farm Forestry in RD Project	2.0	-	-
	Algeria	Germany (GTZ)	1976-83	Integrated Agro-Forestry - Small Scale Wood Industry	4.5	Silviculture, Pasture, Protection	0.4
	Egypt	Canada (CIDA)	1977	Reconnaissance study for newsprint paper mill using bagasse as basic raw material	0.1	-	-
		Canada (IDRC)	1980--	Casuarina Research	0.2	Improvement of Casuarina use and timber production	-
		USA (PL 480)	1980-1	Research	0.1	Windbreaks and Shelterbelts	-
		" "	1980-1	Research	0.2	Genetic Improvement of Eucalyptus	0.2
		" "	1980-1	Research	0.5	Termite Control	0.5
		" "	1980-1	Research	0.2	Technological Properties of woods	0.2
	Ghana	FAO	1981--	Forestry Development and Reforestation	1.4	Species and Provenance Trials	0.4
		IBRD	1977-81	Commercial Plantations in RD Project	1.9	-	-
		"	1979-84	Commercial Plantations and Forest Management	15.0	Genetic and Establishment Trials	0.4
	Iran	Germany (GTZ)	1976-77	Protection, Statistics, Vocational Training	0.4	-	0.4
		UK	1975-77	Research	*	Silviculture and Management	-
	Iraq	FAO	1977-81	Forestry Research and Development	1.1	Species/Research in Soils, etc.	-
	Jordan	Canada (IDRC)	1976--	Afforestation	0.2	Tree Establishment on Eroded Land	0.2
	Morocco	IBRD	1978-81	Erosion Control in Afsu Development Project	2.3	-	-
		"	1980-85	Commercial Plantations	3.3	Species and Establishment Trials	0.3
	Portugal	Various	1980--	Forest Training Center	0.4	Forest Operation Techniques	-
		USAID	1980-85	Fire Control in TA and Training Project	2.1	-	-
		IBRD	1980-85	Commercial Plantations	14.0	-	-
	Tunisia	Canada (IDRC)	1975--	Alfa Grass	0.2	Ecology, Cultivation and Harvesting	0.2
		" "	1977--	Shelterbelts	0.2	Effects of Shelterbelts on Crops and Microclimates	0.2
		USAID	1978-84	Forestry and Range Improvement in RD Project	0.1	Tree Plots	0.1
		"	1978-81	Erosion Control/Extension in RD Project	2.8	-	-
		USA (PL 480)	1980-81	Research	0.1	Vegetative Propagation of Pines	0.1
		IBRD	1981-86	Plantations and Erosion Control in North West RD Project	1.0	-	-
	Turkey	Germany (GTZ)	1980--	University - Wood Technology	0.2	Wood Technology	0.2
		IBRD	1978-83	Expansion of Integrated Forest Management	66.2	-	-
	Yemen AR	Germany (GTZ)	1981-83	Erosion Control Agro-Forestry	1.4	Erosion Control	0.2
		IBRD	1979-84	Sand Dune Stabilization and Windbreaks in Agriculture Project	4.1	-	-
	Yugoslavia	IBRD	1981-86	Plantations and Logging in Macedonia Agriculture Project	1.4	-	-

Region	Country	Supporting Agency	Year	Type of Project[1/]	Approximate Total Aid Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
Latin America and Caribbean	Argentina	Germany (FRG)	1978-82	Silviculture - Wood Technology	0.9	Wood Technology	0.1
		IBRD	1979---	Forestry Plantations	30.6	-	-
		IDB	1978---	Small Development with roads and port facilities	6.0	-	-
		FAO	1979	Forestry Research	0.1	Entomological Studies	0.1
		"	1980	Forestry Development	0.1	Studies on Logging Methods	0.1
	Bahamas	IDB	1980	Forestry Development	0.1	-	-
	Barbados	Canada (CIDA)	1978	Particleboard research	0.8	Particleboard research	0.6
	Belize	UK	1978-82	Research	?	Silviculture	-
	Bolivia	Canada (CIDA)	1979	Feasibility Study for a Wood-based Complex in Los Chimenes	0.2	-	-
		Canada (IDRC)	1979---	Afforestation	0.2	Species/Provenance and Fertilizer Trials	0.2
		" "	1978---	Afforestation	0.2	Species/Growth Trials in Rainlands	0.2
		IDB	1980-83	Fuelwood and Poles in RD Project	0.1	-	-
	Brazil	Canada (CIDA)	1977	Technical Assistance to SUDAM (Policy Advisor)	-	-	-
		" "	1977	Post-graduate training in Canada and Amazonas	0.2	-	0.2
		Germany (FRG)	1971-3-	University Training and Research	3.2	-	-
		" "	1978-82	Agro-forestry, Plant Protection	1.-	Insects, Biol. Study, Plant Technology, Protection	0.5
		Japan	1979-84	Watershed Management	2.3	Watershed Management Research	0.3
		FAO	1971-76	Forestry Research	2.0	National Parks and Wildlife	0.5
		"	1977-78	Forestry Research	0.5	National Parks and Wildlife	0.5
		IBRD	1977-82	Fuelwood and Poles in AD Project	0.1	-	-
		"	1980-85	Farm Forestry in RD Project	0.2	Species Trials	0.2
		"	1981-86	Strengthening Forest Research Institutes in Agriculture, Research Project	1.3	-	-
	Chile	IDB (CORFO)	1980	National Development Plan	2.1	-	-
		FAO	1977-81	Forestry Research and Development	2.0	Silvicultural Research	0.2
	Colombia	Canada (CIDA)	1977	Pacific Coast Development (CVDBBE)[a]	0.-	-	-
		" "	1980	Sectoral Overview	0.1	-	-
		Germany (GTZ)	1981-??	Management of Rain Forests, Wood Technology	1.0	Tropical Forest Management	0.-
		FAO	1975-80	Forestry Research and Development	1.0	Research and Inventory	0.5
		IBRD	1975-84	Fuelwood and Poles in Agriculture Project	0.?	-	-
		"	1976-81	Small Farmer Tree Farming in RD Project	0.2	-	-
	Costa Rica	Germany (GTZ)	1979-82	Agro-forestry, Training, Research	0.5	Agro-forestry	0.3
		USAID	1979-80	Management, Reforestation and Conservation	9.0	-	-
	Dominica	Canada (CIDA)	1981	Sectoral Overview	0.1	-	-
	Dominican Republic	USAID	1981	Reforestation Component in Natural Resources Management Project	0.0	Trials	0.1
		IDB	1981	Forestry Sector Investment Study	0.1	-	-
	Ecuador	Belgium	1980-81	Reforestation in Pichincha and Pastaza Districts	1.-	-	-
		UK	1975-7-	Research	-	High Altitude Species Trials	-
		"	1975-78	Research	-	Arid Zone Species Trials	-
		IDB	1981	Identification - Forestry Sector	0.1	-	-
		"	1981	Installation of a Solar Dryer for Wood	0.1	-	-
		FAO	1973-77	Forestry Development	-	Research and Species Studies	-
	Guatemala	FAO	1978-81	Forestry Research	1.2	Seed Trees and Plots	0.-
		"	1979	Forestry Research	0.1	Forest Disease Survey (Pine)	0.-
	Guyana	Canada (CIDA)	1976	Sawmill and Logging Equipment	3.7	-	-
		" "	1977	Technical assistance to Forestry Department	1.-	-	-
		" "	1978	Technical assistance to Guyana Timbers Ltd.	0.3	-	-
		" "	1982	Sawmill equipment to three end-users	3.0	-	-
		" "	1983-87	Technical assistance to Forestry Department Phase II	[illegible]	-	-
		IDB	1980	Feasibility Study for Wood Energy	0.5	-	-
		IBRD	1979-84	Natural Forest Management and Exploitation	10.0	[illegible] Management, Silviculture and Species Trials	[illegible]

Region	Country	Supporting Agency	Year	Type of Project[1/]	Approximate Total or[1/] Loan/Credit/Grant (US$ million)	Research Component	Approximate Research Amount (US$ million)
Latin America and Caribbean (Cont'd)	Haiti	Canada (CIDA)	1982	Sectoral overview with an emphasis on reforestation	0.1	-	-
		USAID	1981-85	Reforestation and Agro-forestry	8.0	-	-
	Honduras	Canada (CIDA)	1978	Feasibility Study of a Wood Base Complex in the Olancho Region	0.5	-	-
		" "	1977	Technical Support to COHDEFOR in different fields of forestry	2.6	-	-
		" "	1978	Forest Inventory of a part of the Central Highlands	1.7	-	-
		" "	1978	Establishment of Fire Protection System and Network in the Olancho Region	1.0	-	-
		Japan	1980-81	Forest Inventory	1.5	-	-
		USAID	1980-86	Management and Institution Building	12.0	-	-
		UK	1975-82	Research	?	Seed Production	?
		"	1976-82	Research	?	Species Trials	?
		IDB	1984	Study of a Pulp and Paper Plant	0.-	-	-
		"	1974	Study of the Alternatives for the Exploitation of Forestry Resources in Olancho	0.2	-	-
		"	1974	Strengthening Timber Industry	0.1	-	-
		"	1975	Strengthening COHDEFOR	0.1	-	-
		"	1976	Training	0.1	-	-
		"	1976	Sawmilling	1.3	-	-
		"	1977	Strengthening COHDEFOR	0.1	-	-
		"	1978	Strengthening COHDEFNO	0.-	-	-
		"	1979	Feasibility Study	0.1	-	-
		"	1980	Forestry Development Project (Olancho)	1.0	-	-
		"	1980	Improvement of Logging Roads	.1	-	-
		"	1980	Reforestation and Management	0.0	-	-
		"	1978	Logging Roads and Sawmill Development	9.1	-	-
		"	1977	Sawmill Development and Social Infrastructure	23.0	-	-
		"	1980	Roads/Logging and Forestry Management	25.2	-	-
	[illegible]	[illegible]	1981-5-	Forest Resources Assessment and Manage- in Energy Sector Project	0.1	Species Trials	0.-
			1979-80	Reforestation in SO Project	0.7	-	-
		UK	1980-82	Research	?	Species Trials	?
		IBRD	1976-8-	Commercial Plantations	1.-	Technical and Economic Feasibility	-
	Jamaica	Canada (CIDA)	1981	Timber Grading	0.1	Structural Grading for Pine	-
		Germany (GTZ)	1978-82	Management of Rainforest Research	1.1	-	-
		FAO	1979-80	Forestry Development	0.2	Logging Techniques	-
		IBRD	1978-83	Forest Research in Tropical Agriculture Project	1.2	Species and Establishment Trials	0.-
		"	1981-86	Plantation Farm Forestry and Strengthening Research	17.0	Forestry Infrastructure and Species Trials	1.-
		"	1981-86	Plantations and Exploitation in ED Project	0.9	-	-
	Nicaragua	Canada (CIDA)	1980	Sectoral Overview	0.1	-	-
		UK	1975-79	Research	?	Species Trials	?
		IDB	1976--	Management and Fire Control	1.3	-	-
		"	1981--	Forestry Development (Atlantic Zone)	8.0	-	-
	Panama	USAID	1976--	Reforestation and Institution Building in Watershed Management Program	1.1	-	-
	Paraguay	Japan	1979-8-	Re-afforestation and Wood Processing	1.1	Regeneration Trials	0.1
		"	1980-83	Forest Inventory	1.5	"	-
		FAO	1981	Forestry Research	0.1	Assistance in Research Program	0.1
	Peru	Brazil	1980-81	Forest Research in Colombia	1.0	Reforestation Techniques	1.0
		"	1980-81	Agro-forestry in Pucallpa and Jaramacra	?		
		Canada (CIDA)	1982	Technical assistance to INFFP, INPDR and the CEPEFP, including logging and research equipment	1.0	Research equipment	
		" "	1982	Establishment of a post-graduate school in forestry sciences at La Molina University (Forest Management and Inventory)	1.4	-	-
		" "	1982	Technical Assistance and a loan for logging and sawmilling equipment	10.1		
		Canada (CIDA: Andean Pact)	1978--	Forestry Technology	3.1	Physical Mechanical Properties Testing Methods	0.1
		"	1980--	Afforestation	5.-	Species Trials, Silvicultural Systems	0.-
		Germany (GTZ)	1980-81	Management of Rain Forest, Silvicultural Systems, Reforestation, Research	1.-	Land Planning and Establishment Trials	0.-
		USAID	1976	Erosion Control in Land Use Improvement Project	0.2	-	-
		"	1980-82	Forestry TA in Soil Conservation Project	0.1	-	-
		"	1980-82	Land Use Planning	1.0	-	-
		"	1980-86	Reforestation - Sepsa	0.5	-	-
		"	1979	Reforestation in Watershed Project - ADEADEN.C	0.1	-	-

Region	Country	Supporting Agency	Year	Type of Project[1]	Approximate Total AID/ Grant/Credit/Grant (US$ Million)	Research Component	AID/ Private Research Allocate (US$ Million)
Latin America and Caribbean (Contd)	Peru (Contd)	FAO	1973-78	Forestry Development	7.6	Species and Establishment Trials	0.1
		"	1978-81	Forestry Research	0.7	Logging and Sawmilling	0.5
		IBRD	1980-85	Reforestation in Pucallpa Project	0.5	"	"
	St. Lucia	Canada (CIDA)	1976	Feasibility Study for a Sawmill and Planner Mill	"	"	"
		" "	1981	Forest Inventory, Preparation of Management Plan and Training Awards	0.1	"	"
					0.5	"	"
	Trinidad	Canada (CIDA)	1977	Forest Management Inventory	"	"	"
	Grenada	FAO	1980-81	Forestry Research	0.1	Dune Protection and Rehabilitation	0.1
		"	1980	Forestry Research	0.1	Wildlife Study	0.1
	Regional	USAID	1979-83	Reforestation for Eastern Caribbean	"	"	"
		"	1979-85	Fuelwood and alternative Energy Sources Research - CATIE	0.1	"	"
		UK	1975-82	Research Support	"	Various Trials	"
		FAO	1980	Regional Conference - Forestry in Lat.	0.5	Pine Provenance, Propagation, Silvicultural Trials	"
[illegible]	Suriname	Australia	1976	Seed Supply	"	"	"
		Canada (IDRC)	1976	Forestry Cooperative Research in Africa	"	Seed for Trials	"
		"	1981	Forestry Cooperative Research in Africa	"	Forestry Cooperation	"
		Denmark	1975-81	Forestry Cooperation	2.0	Forestry Cooperation	0.2
		Indonesia (SIDA) (FAO Executed)	1975-81	Integrated Forest Tree Seed Center	"	Improvement of Genetic Resources	"
				Forestry Planning, Education and Local Community Development	1.0	Reforestation	0.1
		UK	1975-82	11 Specific Research Projects with Immediate Applications	"	Pine Provenance Trials, Silvicultural Trials, Reforestation Trials	0.4
		USAID	1980-84	Support to Caribbean Forest Resources Management Project	"	"	"
		"	1978-83	Natural Resources Information Systems Environment Information Base Project	"	"	"
		"	1981-85	Research	0.5	Pine Trials Caribbean Pine	"
		"	1981	Research	0.2	Innovative & Genetic Research	0.2
		"	1981-83	Rural Forestry and Conservation Support to CARE Program	1.0	"	"

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THE GLOBAL ENVIRONMENT MONITORING SYSTEM

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THE GLOBAL ASSESSMENT OF TROPICAL FOREST RESOURCES

UNITED NATIONS ENVIRONMENT PROGRAMME
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

UNEP/FAO TROPICAL FOREST ASSESSMENT

INTRODUCTION

Growing world concern over the state and rate of removal of tropical forests has led in recent years to the production of a number of publications giving widely differing estimates of the present extent of that resource and its current rate of change. In order to resolve this question by providing as objective an assessment as possible UNEP and FAO undertook a co-operative study as part of the Global Environment Monitoring System (GEMS). The results of this three year investigation were published in 1981 and 1982 as the UNEP/FAO Tropical Forest Resorces Assessment.

This assessment represents the first attempt to gather together the wealth of information on tropical forest resources that is scattered throughout the world literature, together with the mass of unpublished data held in national agencies and at international centres.

All this information has been compiled into a report according to a single, uniform tropical forest resource classification system developed specifically for this assessment. This is the first time that this has been attempted and is a major reason for considering the UNEP/FAO Tropical Forest Resources Assessment to be the best and most reliable so far produced. It will serve as a baseline against which future tropical forest changes may be measured. The data are to be continually up-dated with the aim of publishing new more comprehensive global tropical forest resource assessments every five years.

THE ASSESSMENT APPROACH

The assessment was carried out on a national basis since this seemed the most reasonable way of presenting the data at this stage. National information was then used to compile regional syntheses (Africa, Asia, Latin America) and these in turn to derive a global assessment.

Forest extent was estimated for each of the 76 countries covered by the assessment using the best available sources of existing information. These included surveys based upon satellite image interpretation (18 countries), together with forest maps, inventories and geographical studies which had been prepared or carried out over the past 25 years. Throughout the survey a dialogue was maintained with the forest services of the countries concerned and in three cases the assessment was carried out by the countries themselves. Rates of forest removal were either taken from existing documents or derived from assumptions based, for example, on the degree of shifting cultivation or upon agricultural statistics. These rates were used to extrapolate forest extent to a common baseline of December 1980. Satellite image interpretation was used to verify estimates where necessary, to correct conflicting figures, and for 13 countries for which no data were available, to derive the primary estimates.

Since national data sets varied greatly in form it was necessary to approach each individually in order to recast it into a common analytical format. The quality of the estimates is, therefore, a function of the quality of the data and the reasonableness of the assumptions used in their compilation.

As a result of these differences in information quality, estimates of forest cover and deforestation rates are judged to be very reliable in only 15 out of the 76 countries surveyed. In terms of total area of closed forests, however, this represents 40 per cent of the forest extent data, largely because Brazil, with 30 per cent of the world's closed forests, is in the very reliable group. A further 38 countries (covering 40 per cent of the total closed forests) have very good baseline information on forest cover. In the remaining 23 countries both baseline data and deforestation rate estimates are considered to be of medium to poor quality. This latter group, however, contains only some 20 percent of the total world closed forests and 29 percent of the total world open forests.

Projections into the near future have assumed constant rates of deforestation based on those determined for each country, but it must be stressed that these national deforestation rates could increase or get less in years to come. Given these constraints, the quality of the data, and the necessary number of assumptions the projections can only be broadly indicative of trends and future states and should, therefore, be viewed with caution.

TROPICAL FOREST CLASSIFICATION

In order to make an assessment of the extent of tropical forests and the rate at which they are changing, it is first necessary to define exactly what is meant by the term 'tropical forest' and to decide on definitions for both the various forest associations that make up a tropical forest and the derivative associations that result when tropical forest is removed. Many of the conflicting statements on the extent of tropical forests and their removal rates have arisen because authors have not always included the same range of forest formations in their consideration of tropical forests. Exclusion of even a few formations between consecutive assessments can lead to big differences in estimates of forest extent and, unless carefully examined, can lead to the derivation of forest removal rates far different from those intended by the authors. In order for the UNEP/FAO assessment to be meaningful, therefore, it was first necessary to create a simple but universally applicable classification that took into account all the main tropical forest formations that have arisen due to differences in botanical composition, ecological and climatological setting, and, most importantly, from a history of encounters with man.

Although a large number of tropical forest classifications exist, it was decided to make the present assessment classification compatible wherever possible with that used by UNESCO* but with particular emphasis upon management. Only those vegetation types whose woody elements have canopies covering more than ten per cent of the ground are included. Figure 1 shows the different classes of woody vegetation used in the assessment.

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*UNESCO classification of vegetation prepared by the UNESCO Standing Committee on Classification and Mapping of Vegetation on a World Basis. August 1969.

There are two main forest types that have to be assessed separately:

1. Closed forests: Have an interlocking, continuous canopy, many layers, and, usually, abundant undergrowth. They do not have a continuous dense grass layer which would allow grazing and the spread of fires. Closed forests are either broadleaved, coniferous, bamboo or mangrove, and they occur in areas with high rainfall or locally abundant ground water. The term 'tropical forest' has come to mean in popular understanding the moist tropical rainforest which here can be equated with tropical broadleaved closed forests, and it is about this particular forest type that most world concern has been expressed.

2. Open forests: Are mixed broadleaved forest and grassland formations usually without an extensive continuous canopy but with a continuous grass layer under a tree canopy that covers more than ten per cent of the ground (e.g. Cerrado in Brazil, and the wooded grasslands of Africa). Such formations, in general, occur in regions that are drier than those supporting closed forests.

There are also a third major tropical forest type, though its extent is much less than the two main types.

3. Shrubland: Are characterised by a predominance of woody plants between 0.5 and 7 metres in height.

The remaining major classification units relate to what is found in formerly forested areas after the forest has been cleared - in other words, replacement vegetation.

4. Closed forest fallow: Are derived from the clearing of broadleaved and coniferous forests for shifting cultivation and are typically a mosaic of various woody regeneration stages. Patches of uncleared forest and agricultural fields which occur within extensive areas of shifting cultivation are often included within the estimates because it is difficult to separate such complex formations into their component elements.

5. Open forest fallows: Are open forests in various re-growth stages after the original forest has been cleared for agricultural purposes.

6. Plantations: Are afforested stands established on land which has not carried forest within the last 50 years. Stands which have been established through artificial regeneration but which are essentially similar to those they are replacing are not included. Also excluded are rubber, coconut, cacoa and other plantation tree crops, and plantations established for shade.

Tropical forests in the broadest sense today cover some 2970 million hectares which represents 20 per cent of the land surface of the globe. Of this area 40 per cent is covered by closed broadleaved forest, 25 per cent by open forest types, one per cent by coniferous forests and 21 per cent by shrubland. Also in this area are included closed forest fallow (8 per cent), open forest fallow (6 per cent) and plantation (0.5 per cent). Figure 2 shows this in diagramatic form while full regional details are given in Table 1.

The bulk of the closed forest occurs in tropical America where the 23 countries of the region possess between them 57 per cent of the world total. Africa, on the other hand, is the continent of savanna and shrubland containing 66 per cent of the world's open broadleaved forests and 71 per cent of its shrublands.

Forest areas are, however, not distributed proportionally among countries within regions. As is shown in Table 2, for example, three countries (Brazil, Indonesia, Zaire) together contain 48 per cent of the world's total tropical broadleaved closed forest. Angola, Brazil and Zaire hold 38 per cent of the global tropical open broadleaved forest while Brazil alone has almost 30 per cent of the tropical broadleaved closed forests of the world and 21 per cent of the open.

TROPICAL FOREST CHANGE

General causes

Tropical forests are altered in two ways: through deforestation where all the trees in a particular area are cut and removed, the land then being used for non-forestry, mainly agricultural purposes; and through felling where either an area is logged whereby selected trees are removed for industrial use (most commonly in moist closed broadleaved forests) or trees are felled for fuelwood or conversion to charcoal (mainly in the drier open forest formations). It is usual, however, that logged over forests are eventually deforested so that for long term practical purposes deforestation can be considered the major factor altering the state and extent of tropical closed broadleaved forest.

Deforestation

The most important single cause of deforestation is shifting cultivation which is estimated to account for 70 percent, 50 percent and 35 percent of the total areas deforested in Africa, Asia and the Americas respectively. Shifting cultivators clear forest in patches and, if fallow periods are long enough, a forest mosaic of primary forest, secondary growth and traditional agriculture results.

Other significant causes of deforestation are extensive clearing, particularly of open forests, to create grazing lands, and settlement along logging tracks with subsequent expansion into the forest. The former is a particularly significant deforestation cause in the Americas while the latter is most important in Asia and Africa.

Logging

Logging for industrial purposes, even if done carefully and conscientiously, can also lead to forest damage since the felling of a big tree nearly always damages those around it while the tracks necessary for the movement of heavy machinery and the extraction of logs make further inroads into forest that would otherwise not be touched.

These paths are often used subsequently by human settlers with consequent further forest degradation. This is most apparent in Africa and Asia where 70 percent of the deforestation occurs in areas of closed forests that have previously been logged. In the Americas, however, the comparable figure is only 44 percent because most logs are transported by rivers or along existing roads so that logging operations do not create as many new access roads for agriculturalists to exploit.

In addition logging in pure, or nearly pure closed forest stands such as are found in southeast Asia, may be very intensive with as much as 90 cubic metres per hectare being extracted and this may lead to rapid degradation of the closed forest. In the Americas and Africa where no more than 5-20 cubic metres per hectare of wood are extracted, logging is not thought to be directly responsible for impoverishment of the forests.

Fuelwood and charcoal

Wood for fuel and charcoal is mainly obtained from open forests and shrub formations in the drier parts of the tropics. In the 76 countries covered by the assessment the average yearly total production of fuelwood and charcoal was estimated to be 1,100 million cubic metres during the period 1976-79. This represents 0.6 cubic metres per inhabitant per year and is some eight times the production of wood logged for industrial purposes. In many areas due to the almost total dependence of the rural population upon wood as fuel, especially in Asia and Africa, the natural woody vegetation is being removed at a very rapid rate, or has already disappeared. Current annual wood production for energy production is estimated to be 736 million m^3 in Asia, 314 million m^3 in Africa and 210 million m^3 in tropical America.

Plantations

Plantations do not replace indigenous undisturbed forest but by providing an additional source of wood for industrial and energy purposes, they alleviate the exploitation pressure on these forests. The importance of this can be seen, for example, in Brazil where 11 million of the 38 million m^3 of wood used annually for charcoal production and fuel are obtained from Eucalyptus plantation, with the remainder coming from closed forest (6 million m^3) and the drier open forest (21 million m^3). Without the plantations, the degradation of the natural forests would be much greater.

At the end of 1980 there were some 11.5 million hectares of industrial and non-industrial plantations in the 76 countries surveyed, and this area is increasing at an annual rate of 1.1 million hectares. Although this rate has greatly accelerated over the last ten years, and should continue to increase, the ratio areas of planted and areas of closed or open forests cleared still remains very high. As can be seen from Table 3, these replacement ratios are highest for Asia where it is expected during 1981-1985 that one hectare of plantation started for every 4-5 hectares deforested - comparable figures for the Americas and Africa will be 1:10.5 and 1:29 respectively.

Closed forest clearance

Estimates of the annual deforestation rates for tropical closed broadleaved forests are given in Table 4. Projections for the period 1981-1985 indicate that the annual deforestation rates in both the African and Asian regions will be around 0.60 percent (or six out of every 1000 ha.) which is similar to their 1976-1980 rates. In the Americas the 1981-1985 deforestation rate is expected to be very slightly higher at 0.63 percent per annum. These deforestation rates are much lower than those given in previous estimates and represent the removal of only 7.5 million hectares each year. Projections suggest, assuming deforestation rates remain constant, that by the end of the century 88 percent of the present world cover of closed tropical broadleaved forests will still remain.

There are considerable differences between the rates at which countries are utilizing and altering their closed forest resources. If present trends are maintained nine countries will have used practically all their closed broadleaved forests within 30 years, and a further thirteen countries will have exhausted theirs within 55 years (Table 5). The nine countries, however, currently represent only 1.7 percent of the total tropical closed broadleaved forest resources. When both the above groups are combined, they together account for 11 percent of the total world tropical closed forest.

Open forest clearance

In the Americas and Asia the annual deforestation rates for open forest are similar to those for closed forest (0.59 and 0.61 percent respectively). In Africa, however, the open forest removal rate is markedly lower (0.48 percent per annum) largely because there is relatively less agricultural pressure on the open forests. Details of the deforestation rates for open forests are given in Table 6. These rates mean that throughout the tropics each year a total of some 3.8 million hectares of open tree forest are cleared.

The majority of open tropical forests are found in Africa where there are about 486 million hectares of wooded grassland. Inspite of the relatively low deforestation rate for open forests in tropical Africa as a whole, there are considerable local differences. Eight countries (Table 7) have deforestation rates, higher than one.

The Americas present a different picture and only Venezuela has a deforestation rate higher than one. Brazil alone has 72 percent of the open forest of the Americas, with an annual deforestation rate of 0.66 percent. (Table 8).

Data on deforestation of open forests in Asia are scarce. The highest known deforestation rate in Asia is that of Thailand (2 percent) (Table 9).

learance

Although coniferous forests comprise only one percent of the total world tropical forests, they are the component that is at present most threatened. This is particularly so for the 25 million hectares of coniferous forest in tropical America comprising the pine forests of Central America, the Podocarpus forests of Ecuador and Peru, and the Araucaria forests of Brazil. Some 312,000 hectares of these forests are being removed every year which is a rate that is twice as fast as that for tropical forests as a whole. The situation is serious for all the American tropical coniferous forests but particularly so for the Araucaria forests of Brazil. A similar situation exists with the coniferous forests of South Asia and Eastern Africa with the position being most serious in Kenya and Ethiopia.

CONCLUSION

The present assessment has shown that the rates of clearance for tropical forests are much lower than had been previously thought. This is true for both the moist closed broadleaved forest and the open forest formations of the drier regions. Of the major tropical forest types, only the coniferous forests are presently under any serious threat when considered from the global point of view.

These findings are no cause for complacency. They do, however, indicate that there is an unexpected breathing space during which proper sound conservation and management strategies can be designed and implemented. More basic data are needed on such urgent questions as tropical forest species dynamics (particularly of closed forests), forest production and the minimum area required to conserve a given tropical forest community in such a way that it can maintain itself. Without this essential information long term conservation measures may prove inadequate and the valuable genetic potential of tropical forests may well be squandered.

Figure 1

FOREST CLASSIFICATION OF NATURAL WOODY VEGETATION

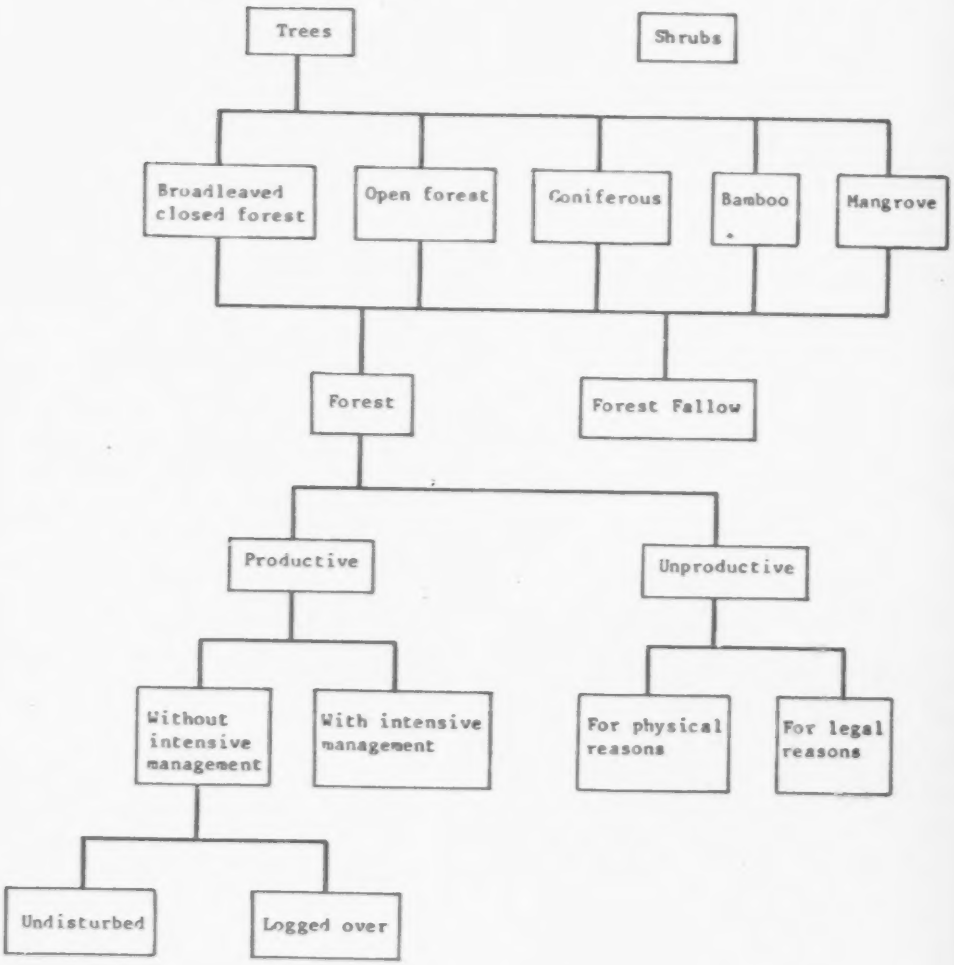

Figure 2:

GLOBAL AREAS OF TROPICAL WOODY VEGETATION

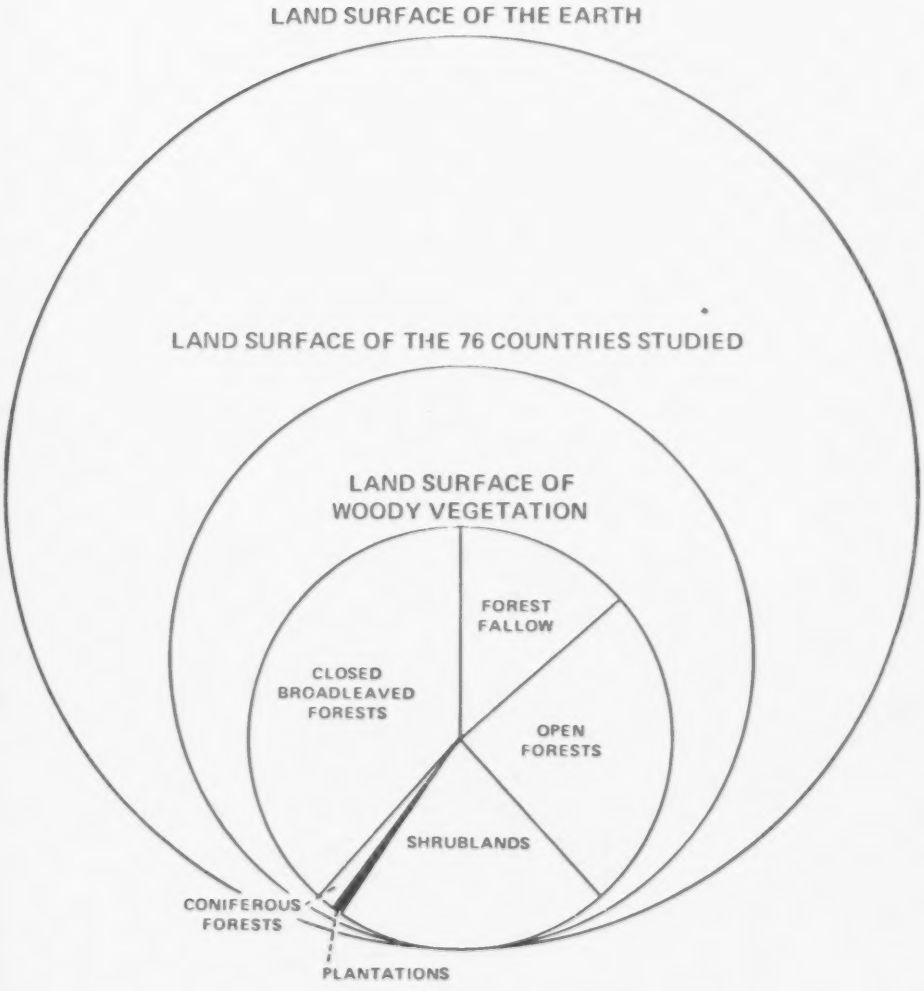

Table 1

STATE OF THE WORLD'S TROPICAL WOODY VEGETATION

	THE AMERICAS		AFRICA		ASIA		THE WORLD
	Area in '000 ha	% of world	Area in '000 ha	% of world	Area in '000 ha	% of world	Area in '000 ha
Closed Forest	678,655	56.5	216,634	18.0	305,510	25.4	1,200,799
Open Forest	(216,977)	29.5	486,445	66.2	30,948	4.2	734,390
Fallow of Closed Forest	108,612	45.3	61,646	25.7	69,225	28.9	239,483
Fallow of Open Forests	(61,650)	36.2	104,335	61.4	3,990	2.3	169,975
Shrubland	145,881	23.4	442,740	71.0	35,503	5.7	624,124
							2,968,771

Table 2

FOREST COVER IN SOME COUNTRIES AS PERCENT OF WORLD TOTAL

	% of world total	
Closed and open forests		
Zaire	9.2)	
Brazil	26.5)	41.9
Indonesia	6.1)	
Peru	3.7	
Angola	2.8	
Bolivia	3.5	
India	3.0	
Total	54.8	
Closed forest		
Zaire	8.8)	
Brazil	29.7)	48.0
Indonesia	9.5)	
Peru	5.8	
India	3.8	
Colombia	3.9	
Bolivia	3.4	
Total	65.0	
Open forest		
Brazil	21.4)	
Zaire	9.8)	38.1
Angola	6.9)	
Sudan	6.4	
Tanzania	5.4	
Botswana	4.4	
Republic Centroafrique	4.3	
Total	58.3	

Table 3

DEFORESTATION/PLANTATION RATIOS

	Closed and open forest (ha planted : ha deforested)	Closed forest only (ha planted : ha deforested)
The Americas	1:10.5	1: 8
Africa	1:29	1:11
Asia	1: 4.5	1: 4

Table 4

ESTIMATED ANNUAL DEFORESTATION RATES IN CLOSED FORESTS

	Deforestation rates (as percent)		Total areas deforested (in '000 ha)	
	1976-1980	1981-1985	1976-1980	1981-1985
The Americas	0.60	0.63	4,119	4,339
Africa	0.61	0.61	1,333	1,331
Asia	0.59	0.60	1,815	1,826
Total			7,267	7,496

Table 5

CLOSED FOREST DISAPPEARANCE

	Less than 30 years		Between 30 and 55 years	
	No. of countries	% of region's closed forest	No. of countries	% of region's closed forest
The Americas	4	0.9	7	14.8
Africa	3	4.8	5	1.3
Asia	2	1.1	1	2.8
The World	9	1.68	13	9.3

Table 6

ESTIMATED ANNUAL DEFORESTATION RATES IN OPEN FORESTS

	Deforestation rates (as percent)		Total areas deforested (in '000 ha)	
	1976-1980	1981-1985	1976-1980	1981-1985
America	not calculated	0.59	not calculated	1,272
Africa	0.50	0.48	not calculated	2,345
Asia	not calculated	0.61	not calculated	190
Total				3,807

Table 7

DEFORESTATION RATES OF OPEN FOREST
AFRICA

	% of African open forest	% of world open forest	deforestation rate
Benin	0.78	0.52	1.7
Burundi	0.003	0.002	2.8
Côte d'Ivoire	1.1	0.73	4.0
Guniee Bisau	0.30	0.20	2.7
Kenya	0.26	0.17	1.6
Malawi	0.84	0.56	3.7
Niger	0.60	0.40	2.1
Rwanda	0.02	0.015	1.8

Table 8

DEFORESTATION RATES OF OPEN FOREST
THE AMERICAS

	% of America open forest	% of world open forest	deforestation rate
Brazil	72.0	21.4	0.66
Bolivia	11.3	3.4	0.06
Colombia	2.6	0.78	1.0
Mexico	0.97	0.29	0.95
Venezuela	1.5	0.45	3.6
Paraguay	13.2	3.9	0.03
Total	101.56[1/]		

1/ Because areas of fallow are included.

Table 9

DEFORESTATION RATES OF OPEN FOREST
ASIA

	% of Asian open forest	% of world open forest	Deforestation rate
Indonesia	9.7	0.41	0.66
Kampuchea	16.4	0.70	0.1
Laos	16.8	0.71	0.67
Thailand	20.8	0.88	2.0

STATEMENT OF DR. WILL POZZI SUBMITTED FOR THE RECORD OF A JOINT HEARING BEFORE THE SUBCOMMITTEE ON HUMAN RIGHTS AND INTERNATIONAL ORGANIZATIONS AND THE SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT
SEPTEMBER 16, 1982

I want to thank the committee for granting an opportunity to cast an additional perspective on this issue.

I am currently an independent consultant who for the last six years has played the role of a catalyst within the academic-scientific community on the consequences of Amazonia and Zaire deforestation (the two largest fresh water basins on the planet) upon climate change (and interest in deforestation on grain harvests in the USSR).

Probably the most appropos analogy to this situation--forestry policy in the tropics and the subject of development--is posed by the historical precedent of U.S. utilities at the end of the 1950s. The demand for power was viewed as inelastic; hence, utilities began undertakings of mammoth expansions of power plant capacity. This, of course, led to a capital shortage in the industry. In its aftermath, energy demand--especially electricity--was "discovered" in the early 1970s to be elastic, or subject to supply and demand. This prompted cancellation of many orders from vendors of the projected capacity expansion, including some plants under early construction. This analogy is exact, of course, because infrastructure development in the tropics must be financed with some assumption of water availibility: water for residential consumption, mining use, and especially agricultural use. To assume that the water supply with full infrastructure development will be the same as it currently is in equatorial basins is a buccaneer attitude, indeed, entirely equivalent to the assumption that had not been questioned--that energy demand was inelastic.

The farsighted climatologist Thorntwaite had stated as early as (1948):

> "We cannot tell whether a climate is moist or dry (i.e., the latter meaning prone to drought) by knowing precipitation (i.e., rain) alone. We must know whether precipitation is greater than or less than the water needed for evaporation (by the surface) and transpiration (evaporation by plant leaves). Precipitation and evapotranspiration are equally important factors."

Water policy should include not only surface waters (river flow) but also surface evaporation (which removes soil water storage after rains) and rains (water returned to the surface) and water vapor inside air. This last concept is most important because of the ubiquity of the atmosphere: the mobility of air. Surface evaporation--as from rain forest or summer deciduous forest--adds water vapor to the surface influenced bottom of the atmosphere (or "planetary boundary layer"). Winds can remove (export) this water vapor or add to the supply (import). Planetary boundary layer circulations can converge or accumulate much more water vapor than provided by mere evaporation rate of the directly underlying surface. This much water vapor--the counterpart set of factors in the atmosphere above permitting--boosting more extensive cloud formation, atmospheric thunderstorms and substorm precipitating clouds then draw upwards through the top of the planetary

boundary layer water vapor, returning it to the surface as liquid rain. The larger the storm, the more rain delivered at one time, flushing water through the porous soil matrix. Hence the porosity of the soil--the pore or air space or pore size distribution--controls the volume of water which can pass through it; the soil interacts with the size of atmospheric thunderstorm. (This interconnected chain of factors constituting planetary ecology).

There are common popular misconceptions of torrential downpours in Amazonia and Zaire Equateur occurring all the time. Actually the equatorial basins are prone to drought. If one examines entire annual water supply delivered as rain, 50 to 75% is traced to origins in very large storms. With such deliveries of water at one time, the bulk of it is forced through the soil under the surface; the largeness of the storms is what is responsible for the appearance of the two largest river systems on the planet both being found here. At the same time, such heavy delivery of water at only a few times increases the erosion potential, as well as the drought potential.

The immediate pragmatic question is what role the rain forester surface plays in this process. Striking differences are found in agro-ecosystem structure structure and atmospheres of the temperate and tropical zones of planet Earth. The maintenance cost exceeds the energy supply made available through photosynthesis to deciduous trees when the sun is at low altitudes in winter, prompting senescence and leaf fall. This process, at the same time, leads to development of topsoil which enhances water retention for transpiration by deciduous tree leaves, Equatorial evergreen forest, on the other hand, retains nutrients exclusively within the phytomass (no leaf fall) so that soil fertility is low and little enrichment of otherwise freely draining sand takes place. During the temperate summer's high solar altitude and during the entire year of the tropics, evaporation of water with leaves provides an energy sink--evaporation absorbs heat energy as in cooling towers--so that temperatures of leaves are cooler. Yet the distinction between the temperate zone and equatorial forest zones seem to suggest that the superior soil development favors greater transpitational potential--and cooling potential--in summer temperate forest, despite the heating and rapid water losses in the equatorial basins.

The counterpart set of atmospheric factors is at work. In theoretical terms, Earth's rotation can be viewed by analogy to a rotating turntable: in trying to draw a straight line across a rotating turntable, it becomes curved; yet it is easy to draw a straight line by holding a pencil point to the side of the turntable. When air converges in temperate lower troposphere, air moving horizontally inwards contracts an air volume inwards at the sides. To conserve angular momentum (momentum of rotation) such contraction of the sides causes a compensatory lengthening of the ends of the volume, inducing upwards vertical flow within. And this is the effect responsible for a spinning ice skater's spinning faster upon pulling her arms inwards closer to her body. So where does this spin come from that is converted into weak vertical motion, assisting cloud development to the rain stage? The closer one gets to the pole (the top of the turntable) the greater the rotation component of the underlying surface added to air ("absolute vorticity") The equator, on the other hand, constitutes the "side of the turntable," not possessing this closely coupled atmosphere structure; rather, it is "barotropic" or behaves as a series of partly decoupled layered structure of the troposphere. With a layered structure

a supplemental outside mechanism is required to converge enough moisture to tunnel thunderstorm cloud growth through these layers. This explains the respective contribution by large atmospheric thunderstorm versus small storms and individual clouds to total rain water supply. Soil water storage per unit area may not be important--freely draining sands can be tolerated--where convergence over large areas of homogeneous rain forest of water vapor in planetary boundary layer air is made possible.

To what extent is such possible theoretical expectation realized? Radiosonde balloon temperature recordings over Kinshasa, Zaire, reveal two essential differences: during the dry season (June, July, and August) the atmosphere has an intricate layered thermal structure, even reminiscent of the stratosphere. As a painless excursion into physics air and gases are viewed as a collection of molecules and atoms; if they have higher energy, then they will move at higher speeds and more will strike the container walls with greater frequency. Finally, if one gas is at a higher temperature it will have more internal energy, higher motion of the particles, so that more diffusion of the particles will occur outward (or heat flow from where temperatures are highest to where they are lowest). Where temperatures of two gases are equal, the rate of diffusion of molecules will equal one another, and no net exchange from one to the other will take place. "Stable" layers are those in which temperature increases with height, the reverse of the normal temperature decrease with height. Consequently, just as evaporation of water absorbs heat, condensation of water vapor into cloud droplets releases heat; but the temperature increase with height in as many as seven inversion or stable layers prevents cloud rise. No rain reaches the surface at all. During the wet season, on the on the other hand, no stable but only "neutral" layers (same temperature with increasing height) are found; yet these themselves still offer enough resistance to make concentration or convergence of moisture within the planetary boundary layer a prerequisite to support the necessary storm size needed to penetrate through the atmosphere, dissipating the heat of the surface.

This is also borne out in solar and terrestrial radiation recorded at Kinshasa: during the dry season surface-heated air rises to the top of the planetary boundary layer and can ascend no farther. A thin layer of "fair weather" cumulus expands ouwards (horizontally, since it cannot rise vertically), creating a shelf cloud which reduces direct solar radiation (sunlight) entirely, leaving only scattered radiation (skylight). The amount of solar energy reaching the surface remains around a constant value during this season (reflecting the persistance of cloud). During the wet season greater variability of solar radiation reaching the surface is found. This variability includes both greater scattering from higher or deeper clouds through the troposphere and less scattering when the overcast from "fair weather" cumulus clouds is absent. This also illustrates that the dry season overcast lowers direct heating of the surface by reflecting away solar radiation.

In conclusion, the Kinshasa conditions support th e theory. However, Kinshasa is somewhat nearer to the Atlantic and, hence, possibly subject to the South Atlantic High pressure cell leading to compacting, descending air, and hence a layered structure which might be absent elsewhere. An examination of Kisangani reveals that the dry season is not quite as marked, but a less-pronounced trend is still exhibited. The atmospheres of temperate and equatorial-tropical zones are very different, calling for a more guided policy of infrastructure planning in these countries. Yet meteorological grids are the first budget tightening cut made within these countries localities. Agricultural policy cannot be divorced from meteorology

within the tropics at the present time. The role of rain forest in this process is virtually unknown. If I were asked how long would be required to discern these factors, I should have to say, "Perhaps forever." Not only meteorological grids are deteriorating in the countries in question, but even in the U.S.A. my colleagues and I have not been able to find funding for our own research, so that the results reported here have been funded entirely out of my own pocket.

This is the appropriate time to pick up the thread of agency involvement in this question. Almost no real advancement of Thornthwaite's seminal idea has occurred: most of his followers have merely utilized the water balance technique he had originally developed which is now entirely outdated. The other group is the forest meteorologists. The reason for their selection of crude molecular scale diffusion or mean aerodynamic formula is not hard to see: their primary emphasis is on water use of forest and crops where evaporation to the planetary boundary layer is considered a "loss" of soil water. Development of this new integral approach is requiring frontier breaking research by several individuals not afraid of taking apart several disciplines and putting them back together again in keeping with the unique peculiarities of equatorial meteorology and tropical meteorology, soil science, and ecology.

In 1976 contact with Warren Washington at the U.S. National Center for Atmospheric Research (supported by the National Science Foundation) led to a cooperative effort toward the use of the "GCM" or computer model of the global atmosphere to simulate consequences of both global scale and tropical deforestation upon climate change and role of the biosphere in climate. This entailed my development of a vegetation parameterization to incorporate into the bottom of the model atmosphere. At this time the surface had been viewed as exclusively albedo (light or dark controlling solar energy absorption) and a site of aerodynamic roughness or friction to atmospheric flow over the surface. I had contacted the other vieing GCM; Manabe of the NOAA GFDL did not think the surface was important in atmospheric events! I had emphasized the thermodynamics or the thermal (rather than merely mechanical).

The outcome of various planetary layer research programs had been that its structure changes with degree of heating, from below by the surface. The actual sequence of events over forest was on the order of every five minutes: large thermals (thermally heated air expands, becoming less dense than the surrounding air and is thereby propelled upwards by buoyancy like air bubbles in water, a hot air balloon, or a submarine) sweeping air around forest trees up into it and upwards. These thermals upon reaching the inversion or stable layer which capped the planetary boundary layer, a wave was formed capturing some of the warmer inversion air (since temperature increases with height in the stable layer). This mixing of the two airs--cool, moist air carried upward in the thermal from the forest and warm, dry inversion air--thickens the planetary boundary layer and returns some of the mixed dry air back to the surface.

But the actual height reached by the planetary boundary layer is miniscule, compared with the bulk of the troposphere (the weather-active lower atmosphere below the stratosphere which contains most of the atmosphere's mass). The thermals transport process does carry water vapor to the top of the planetary boundary layer, but, as noted above, the existence of multiple "stable" or isothermal layers above precludes anything other than formation of a thin overcast of "fair weather" cumulus. The early Riehl-Malkus "hot tower" hypothesis of 1958 had predated the findings of "GATE"(Global Atmospheric Research Program Atlantic Tropical Experiment conducted by U.S.A., Britain, Deutschland, and U.S.S.R) that the planetary boundary layer process is too weak to give rise to thunderstorms--within the tropics, that is. Intruding middle tropospheric "troughs" or low pressure focii are prerequisite to large storms providing forced uplift (when air is drawn upwards through the top of the planetary boundary layer, compensatory horizontal inflow occurs at its sides).

Examination of satellite photographs of cloud formations over the Amazon Basin had revealed the same pattern (since borne out by the Belgian collected daily Zaire rain grid). The idea of using a GCM was abandoned, since without knowledge of circulations within equatorial basins, simulations would be of dubious value. Alternatively, I designed the logistics of a field experiment including aircraft transects of the planetary boundary layer with rapid response temperature and wind detectors and a storm budget measurement program. Zaire had been selected based upon the difficulties other people had encountered, dealing with the Brazilian military (Amazonia is a national security area, falling directly under the National Security Council).

A meeting was convened at the National Science Foundation, wherin the entire Atmospheric Sciences Directorate was present (Ken Bergman, Alan Hecht, and Dr. Bierly were helpful in setting up the meeting; Herbert Riehl, one of the world's ranking tropical meteorologists, came at his own expense.) Observers from NOAA Division of Research and Development, NASA, and DOE participated. State Department was invited but did not attend.

The virtual dearth of information on equatorial meteorology entailed sampling a mammoth number of variables possibly relevant. A passing glance at the NSF atmospheric sciences budget will dispel any misconception that they could incur the full cost of such a field experiment. Without funding from the development community, recourse would have to be made to World Meteorological Organization, which would take years. As an alternative contingency plan, sleuthing on my part over the last 20 years of African history revealed that the Belgians had erected a meteorological grid during their colonial occupation of Zaire, collecting mean data. I traced that some of these data had been sent to this government decades ago. With it, reconstruction of equatorial meteorology over Zaire was commenced to construct a computer model in conjunction with Michael McCumber of NASA-GLAS. With it we could conduct simulations of deforestation and identify relevant variables.

In closing, I should respectfully recommend to the distinguished members of the Committee that they exercise oversight to observe AID's involvement in this research and field program. By doing so, AID will be assured that development is in accord with, not antagonistic to, the very zone of the world that the aid is intended to bebefit. In this way, the oversights in another era of infrastructure development can be avoided. Thank you.

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